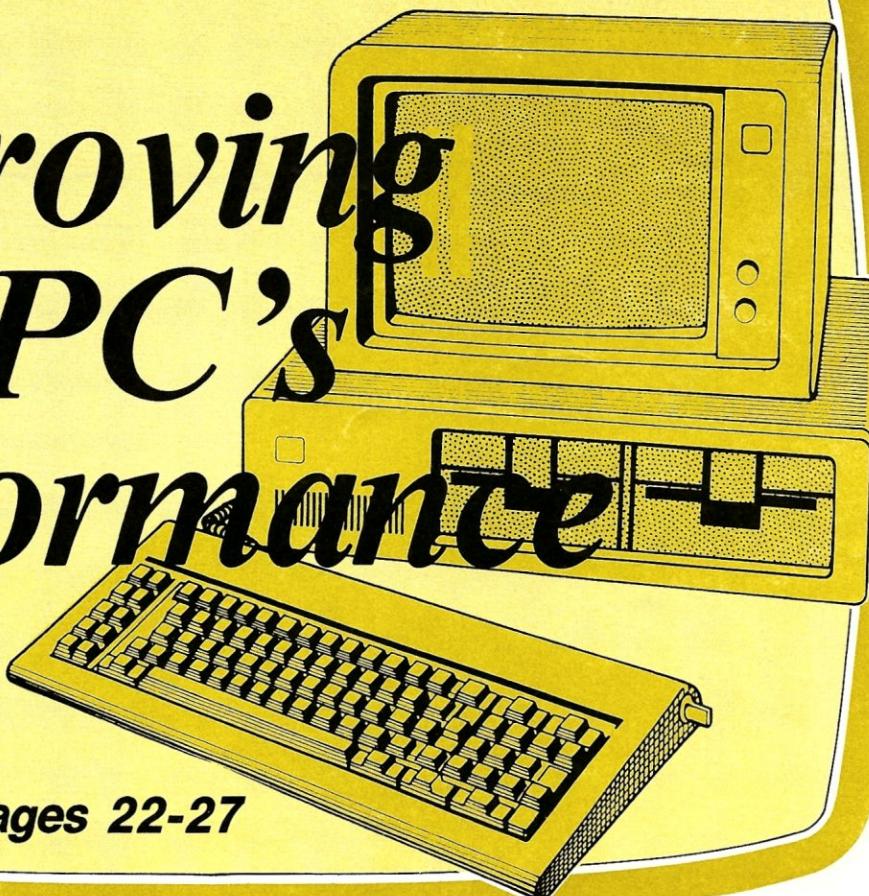


For the Advanced Computer User

Micro/Systems Journal™

Improving The PC's Performance



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July/August 1986

Vol.2/No.4

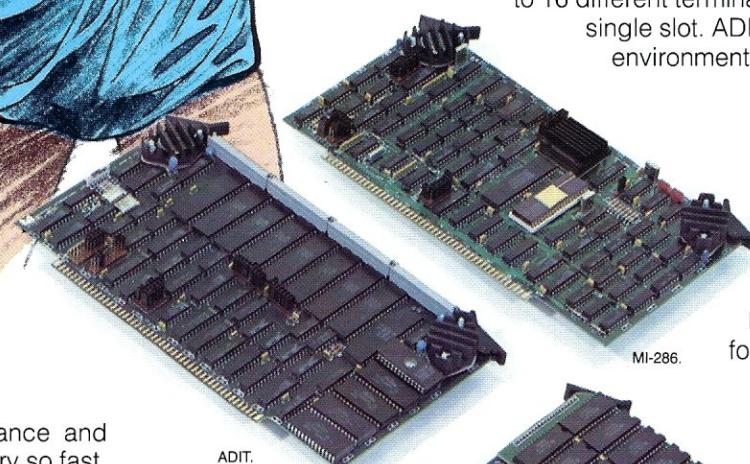
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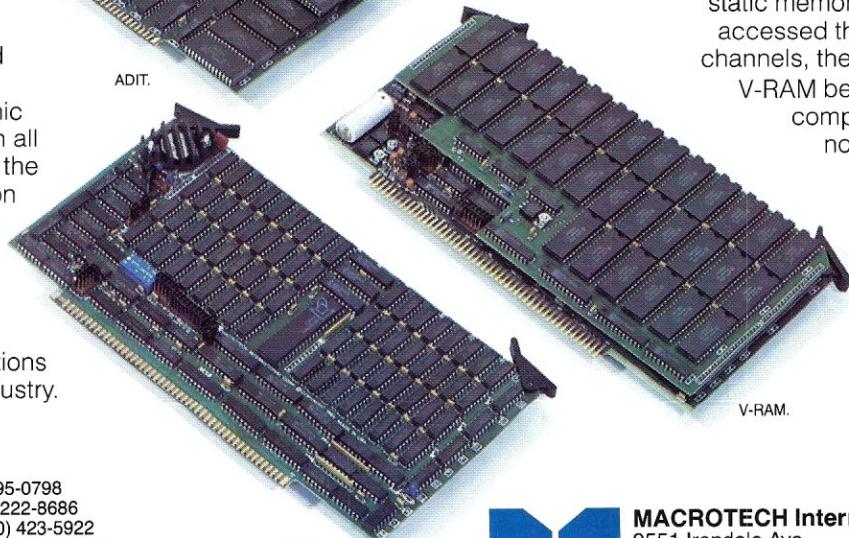
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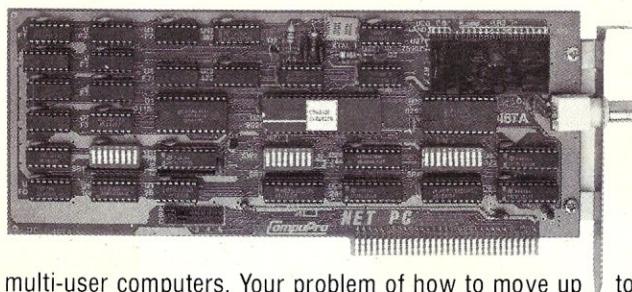
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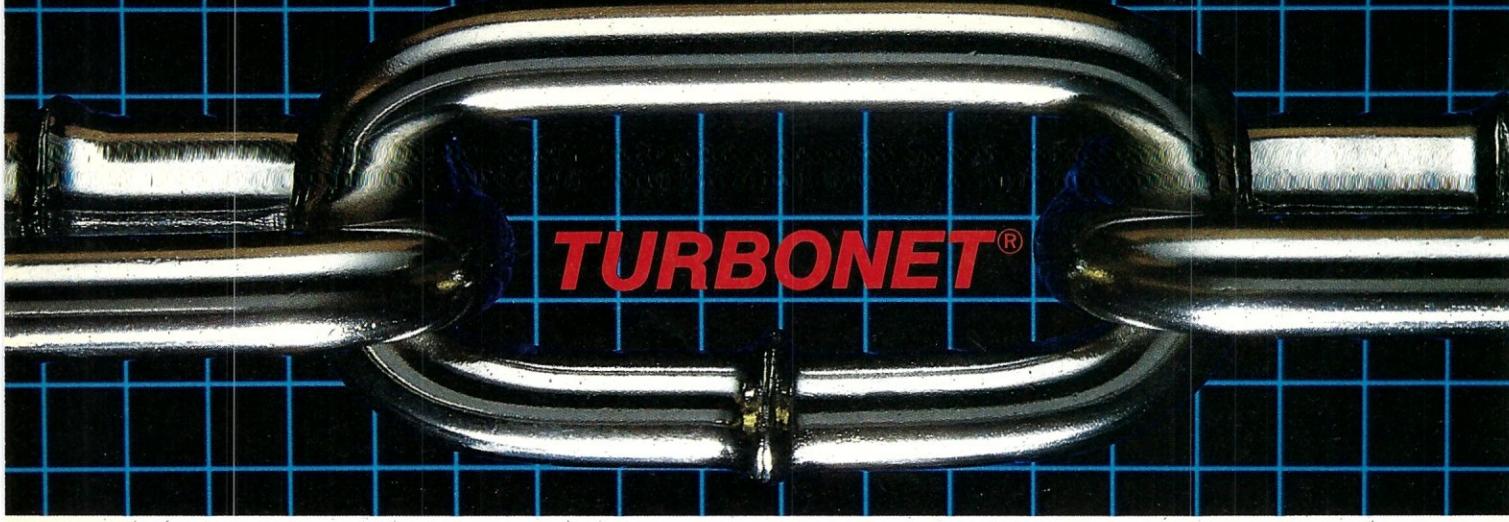
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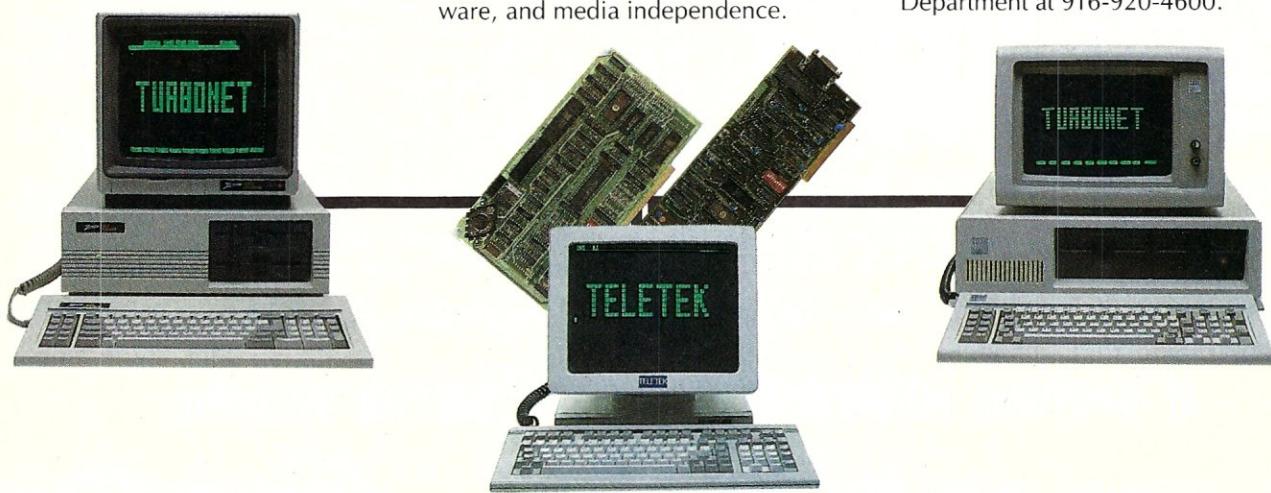
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8088, 8086, 80286	Intel Corporation
IBM PC, PC/XT, AT	International Business Machines
MS-DOS, XENIX	Microsoft
GW Basic	Microsoft
68000, 68010, 68020	Motorola

Editor's Page

by Sol Libes



THE ORIGINS OF MS-DOS

It is interesting to look into the origins of MS-DOS. Microsoft gets the credit for creating what is, without a doubt, the most popular computer operating system in current use. But in actual truth Bill Gates, Microsoft's President, bought it from another company....Seattle Computer Products. And, if the truth be known, SCP never even wanted to create an operating system.

The story starts way back in 1979 when Intel introduced the 8086, the first 16-bit microprocessor. Seattle Computer Products, based in Seattle Washington, was a small start-up company with the sole goal of producing an 8086-based S-100 CPU card. They were very successful in designing the card and getting it into production. However, they had a problem. There was no software around for it.

Digital Research Inc. was working on porting CP/M over to run on 8086-based systems. However, CP/M-80 was going great guns for DRI and they were all involved with venture capitalists, acquiring other companies and laying the ground work for eventually going public and making a big killing. Thus, development of CP/M-86 was given a low priority status.

Microsoft also was involved with big OEMs, like Radio Shack, and did not have the time for small startups like SCP. SCP was successful in acquiring a license from Microsoft for MBASIC and hired a young programmer, Tim Paterson, to translate it into 8086 code so they would have at least one piece of software users could run on their SCP systems.

During 1980 SCP added a 16-bit wide memory card and disk controller cards to form a complete S-100 16-bit system. But they began to worry as they still did not have a disk operating system. DRI kept stringing SCP along, promising, but not delivering. Out of desperation, Tim Paterson quickly created an 8086-based operating system based on the CP/M-80 model. It had the same resident and transient functions and the same memory model. Before the year was out SCP was able to deliver complete systems to users.

DRI eventually released CP/M-86 in the Spring of 1981, just before IBM announced the PC.

ENTER IBM

In 1980, IBM realizing that Apple and Radio Shack were making inroads into their traditional market, the business office, decided they had to take quick action. They approached DRI and Microsoft with intent to license CP/M-80 and MBASIC, the personal computer industry standards at the time. They found Microsoft to be very receptive but DRI took a rather independent stance.

During one of IBM's visits to Microsoft they explained the problems they were having coming to terms with DRI. Bill Gates saw an opportunity. He sold IBM on the idea of using the new Intel 8088 microprocessor instead of the 8080 and billing the unit as a 16-bit computer, and that he would provide both a 16-bit version of MBASIC and a disk operating system.

But IBM was in a real rush to get the product out the door, before Apple and Radio Shack got too entrenched in the office market. Bill Gates, realizing that time was of the essence, decided to acquire SCP's operating system and do a quick translation of MBASIC.

Microsoft quickly stuck a deal with SCP. They bought the operating system for \$50,000, granting SCP a royalty-free license to MS-DOS when sold with their systems (including updated versions). Tim Paterson went to work for Microsoft.

IBM, with extensive experience with Disk Operating Systems and knowing their customer base, asked that the system be enhanced and made easier to use. But time was running out. So with only a few refinements, IBM released version 1.0 of PC-DOS. The biggest refinement was a user manual, written by IBM, that was designed for a less knowledgeable user and printed in a much more professional manner than traditional personal computer manuals. Anyone who had to cut their teeth on the CP/M-80 manuals realizes IBM must be given considerable credit for taking the industry a major step forward in documentation.

In early 1982 Microsoft delivered the improved version (2.0) of PC-DOS to IBM (it was released in mid '82). The new version represented a major improvement. By then IBM realized that users were going to

add hard disks to the PC and an operating system was needed that provided hard disk support. Thus, version 2 added many UNIX-like file handling functions, friendlier features (e.g. a powerful, easy to use batch processor) and error recovery. Version 2, in fact, bore little resemblance to SCP's original operating system or CP/M-80.

MICROSOFT GOES PUBLIC

Recently Microsoft went public and its chairman of the board, Bill Gates (age 30), sold 80,000 shares of stock for a little over \$1 million. He kept 11,142,000 shares (45% of the stock) worth over \$200 million. It is interesting to note that last year Bill's salary was \$133,000, while Jon Shirley's, Microsoft's President, was almost \$100,000 more than Bill's.

Paul Allen, co-founder of Microsoft with Bill (who has since left the company), owns 6.39 million shares worth well over \$100 million.

It is worth noting that Microsoft was built entirely out of income and did not rely on any venture capital. Sales for fiscal 1985 were over \$140 million (profits were over \$24 million) with well over half coming from OEMs. In fact, IBM, Tandy, and Compaq accounted for 31% and international OEMs (mainly Japanese) accounted for 19% of sales.

WHAT EVER HAPPENED TO SCP?

SCP continued to produce their S-100 8086 system throughout 1982, 1983, and 1984 with considerable success. They also began manufacturing PC-bus products. However, in late 1984 they experienced a plant fire which literally put them out of business.

Thus SCP decided, in early 1985, to sell the company, the most valuable asset of which was the royalty-free license to MS-DOS. In accordance with their contract with Microsoft they notified Microsoft of their intent to sell the company and assign the license to the purchaser. Microsoft, in turn, notified SCP that they could not do this.

The result is that SCP recently filed suit against Microsoft asking that Microsoft be enjoined from interfering with the sale and continuing with the royalty-free arrangement. Further, SCP is claiming that they are also entitled to any revenue from licenses sold to vendors that distribute systems based on chips other than the 8086. This would include IBM's entire line of personal computers. SCP is also seeking \$20 million in damages and if its other claims are not supported by the court, they are asking for a revision of the original agreement with ownership of MS-DOS returned to SCP.

We will try to keep you posted on the outcome of this suit. μ

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News, Views & Gossip

by Sol Libes

GOSSIP & RUMORS

The Wall Street Journal recently described IBM as "the world's most profitable industrial company, it doubled in size in the past six years and could double again by the early 1990s." They also pointed out that "the company has rarely pioneered" but rather waited for smaller companies to create a market large enough to enter and then "bumped" them aside and grabbed "the largest share of the market."

The Wall Street Journal also stated that Dataquest, a respected market research outfit, "estimates that 80% of the 350 companies now supplying personal computers world-wide will go broke or give up the market by the end of 1987."

Quadram is rumored readying a \$600 (base price) AT compatible for introduction late this summer. The system will include 640K of RAM, power supply and keyboard, but no disk drives or controller.

Several dozen companies are rumored to already have 80386-based prototypes running and ready to go into production as soon as Intel starts delivering parts, expected to begin in late August. This means that we should see the first 386 machines being announced this fall. Compaq, AT&T, Tandy, and PC's Limited are expected to be front runners in the race to get systems out the door. IBM is not expected to release their 386 machine until next year and Microsoft is not expected to release its 386-based DOS and XENIX until early next year. This will, undoubtably, cause some standards problems. The Far East manufacturers will likely wait until IBM enters the market before they jump in. Most 386 systems are expected to be designed for CAD, multi-user, network server, etc. applications, not single-user applications, and, early systems are expected to run Unix System V.

IBM and several OEMs are rumored beta testing Version 5 of PC/MS-DOS. This means that it should be released before year-end. It is expected to be specifically tailored for 286-based machines. The new version reportedly has more than 200 commands, offers protected mode operation, can address up to 16-Mbytes of memory, be multi-tasking, and use Unix-like shells. When released, it should have a disastrous effect on the sales of PC/XT machines.

IBM is also rumored evaluating a 1.44Mbyte (formatted), 3½" floppy drive

from Maxell Corp. Several drives makers are also known to be working on drives that will read both the current 720K and the upcoming 1.44Mbyte disks. It is expected that IBM will use the drive in a new version of the AT and in their 386-based system.

It is estimated that there are now over 500 companies making PC/AT bus products. That is more than S-100, Multibus, and VME buses put together. And one mail order outfit (Thompson, Harriman & Edwards) is offering a PC compatible for \$469 that includes 640K of memory and a single drive - adding a display controller, monochrome monitor and DOS brings an entry level system up to just under \$700. Some people are predicting that competition will force the price of a basic PC compatible down to \$500 by Christmas, but I doubt it.

Rumors are that Commodore shipped only 25,000 Amiga machines in its first six months of production, just a fraction of what they had expected to ship. Though the Amiga has been considered by many to be the most innovative machine introduced in 1985, most 68000 programmers have devoted their efforts to the Macintosh and Atari ST machines. Commodore slashed the price in the early spring so that a basic system, with color monitor, was offered, on sale, by some dealers for about \$1,000. This has served to stimulate sales, but how much? In addition to the lack of software, Commodore (as of press time) still was not shipping their long-promised IBM-PC emulator. An enhanced version of the Amiga, with a new operating system, is expected soon.

The Trenton Computer Festival offered some insights into industry trends. PC clones, with dual drives, and 640K of RAM, and mono display were going for under \$700. An XT clone was about \$1,000. Floppy disks were down to 45 cents each. And the Commodore Amiga, with color monitor, could be had for \$1,000.

Apple Computer has disclosed that it will offer versions of UNIX and MS-DOS operating systems for its new high-end 68020-based Macintosh, due in the late fall. Also, it disclosed that it now sells more Macintosh systems than Apple IIs. Does that mean that Mac sales are up, or that Apple-II sales are down?

Phoenix Software, Norwood MA, is offering OEMs the design of an under \$800

PC display controller offering 1280 x 1024-pixel resolution and five modes of operation.

Digital Equipment Corp. is rumored readying the "Vaxmate," an AT-compatible with built-in Ethernet circuitry.

19.2Kbaud MODEM INTRODUCED

I can still remember the old 110baud teletype days and the joys of moving to 300baud, 1200baud, and 2400baud modems. Last year saw the introduction of 9.6Kbaud and now we have the first 19.2Kbaud modem. It is a joint effort of Digital Communications Associates (Alpharetta GA) and Telebit Data Systems (Cupertino CA). The unit is actually an enhanced version of the DCA Fastlink unit (9.6Kbaud) and is usable on regular phone lines.

The new Fastlink unit also handles .3, 1.2, and 2.4Kbaud standard transmissions. It is available as a standalone unit (\$2,395) or PC-card (\$1,995). Owners of the 9.6Kbaud version of Fastlink can upgrade via a kit (\$99) or a factory upgrade (\$250). Either involves changing 4 ROMs.

INTERACTIVE CD ROMS

CD ROMS are the new emerging technology and developers are already talking about the next generation of systems...the interactive compact disk (ICD). The first ICD unit may appear before the end of the year.

ICD is an enhanced CD ROM with graphics and audio added to data storage. The ICD would interface directly to display and audio systems and include the Digital-to-Analog converters to deliver digitized video images and sound directly. The first units expected to reach the market are expected to employ a 68000 microprocessor, use the OS-9 operating system (currently used in the Radio Shack color computer among others), provide 768 x 580 pixels and stereo sound.

The first units to reach the market are expected to be designed strictly for entertainment and not contain computer interfaces. It will be interesting to see how these things develop.

UPGRADING THE AT TO 32-BITS

Intel has been demonstrating an AT with a small board that holds an 80386 and plugs into the 80286 socket, turning the AT into a limited 386 machine. Several companies already have 386 products for the AT in beta test, so it's likely that the products will be released before year's-end. Two of the companies are ARIEL (201-788-2788) and BGI (215-538-3900).

We can also expect to see similar products based on the new NEC V-70 32-bit and V-60 16-bit processors. Both are expected to have enhancements such as built-in math processors and have 286

object code emulation modes. The V60 is already being sampled (\$550) and production is expected to start in August. The Intel/NEC court case should drag on through the courts for about two years depressing sales of the NEC V series chips. Thus, it is unlikely that U.S. manufacturers will adopt the V60/70 chips for use in their systems. NEC is claiming that the V60 is ten times better than the 68020 and 80386 chips. The V70, expected next year, has full 32-bit i/o.

LOW COST 32-BIT WORKSTATIONS RUMORED

More details on the new Commodore and Atari 32-bit workstations are leaking out. Commodore is rumored readying a system based on the Motorola 68020 for introduction in June with deliveries to start in the late fall. The system is expected to sport 1024x720 pixel resolution in monochrome and color with a base price under \$3,000. Included will be a 20Mbyte hard disk, SCSI interface port, 1 Mbyte of RAM (expandable to 4Mbytes and possibly more), five internal slots (proprietary bus), 3½" drive (880Kbytes) and 14.32MHz clock speed.

And Atari is expected to announce their 32-bit system at about the same time. Based on the Western Electric WE32000, it is expected to sport a 1024x1024 mono or color display.

Both systems are expected to run the UNIX operating system and are aimed at specialty markets such as university, engineering/scientific and video graphics producers.

A QUICK LOOK AT THE ATARI 1040ST

Atari introduced the 520ST in June of '85 and less than 9 months later introduced the 1040ST. With 1Mbyte of RAM, an internal 720K floppy and other enhancements, the machine appears to be intended to compete with the Commodore Amiga and Apple Macintosh. And there are rumors an empty IC socket inside the 1040ST is for a graphics coprocessor chip capable of 1000x1000 pixels. Couple this with the fact that Atari has purchased an AT&T UNIX license and there is reason to suspect Atair may enter the scientific workstation market with this system.

Atari is moving very quickly. Although the amount of available software is still meager by comparison to the Mac, it is better than what's available for the Amiga. There are already desktop publishing programs available which should challenge the Mac in the only market niche in which the Mac has achieved any success.

However, Jack Tramiel still appears to be up to his old tricks of demoing prototype products at shows and then not putting

them into production. Two recent examples are a promised low-cost CD ROM player and a box containing a 5½" drive and the ability to run PC software on the 520ST and 1040ST.

FIRST WORM SYSTEM INTRODUCED

Information Storage Inc., 2768 Janitell Rd, Colorado Springs CO 80906, has introduced the first optical WORM (Write Once Read Mostly) drive for the PC (\$2,495). It stores 115-Mbytes in a standard 5", full-height, form factor and is furnished complete with interface card and software. It uses a replaceable data cartridge (\$60). At this price, and considering that most of the software on a hard disk usually does not change, it presents a very attractive alternative to a second hard disk drive.

RANDOM BITS

Elliam Associates, 24000 Bessemer St, Woodland Hills CA 91367 (tel: 818-348-4278) has a new 100-page catalog listing over 8,000 CP/M public domain programs (on 400 disks). The catalog is \$7.50 (\$10 overseas) and disks are available in 75 different formats on 8", 5½", and 3½" disks....IBM recently presented a paper at the International Conference on Acoustics, Speech and Signal Processing describing a PC-based real-time voice recognition system capable of recognizing 20K words. In 1984, IBM had demoed a 5K word system requiring an entire IBM 4341 mainframe with three 190L floating point systems array processors....IBM got rid of its 84 computer stores by selling them to Nynex Corp. They have learned what DEC and Xerox and several hundred computer store operators have learned - selling personal computers via stores is a hard sell.

COMPUTER FLEA MARKETS

July 6: Wilkes-Barre PA. Ham & Computerfest, Coal St. Sports Complex, run by Murgas A.R.C. (KeYTL), (717)388-6863.

July 20: Cherry Hill NJ. Computer Fair, Holiday Inn, Cherry Hill NJ, Rt 70, run by Robert Barlow (201)533-1991.

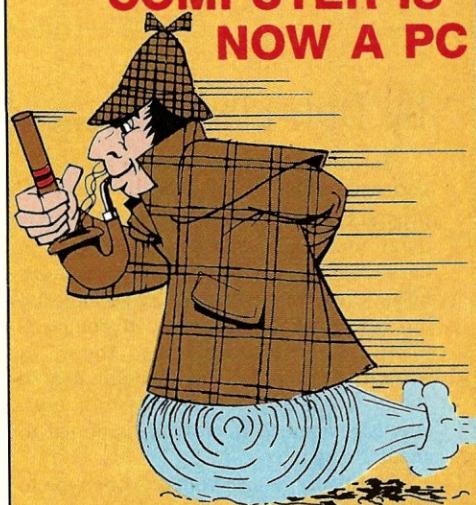
August 3: Suffern NY. Computer Fair, Holiday Inn, run by Robert Barlow (201)533-1991.

August 16: Philadelphia PA. LaSalle University, 20th & Olney Ave., run by Phila. Area Computer Society, (215)951-1255.

August 23/24: Dayton OH. Computerfest-86, Hara Arena, run by Dayton Microcomputer Assoc. (513)268-7225.

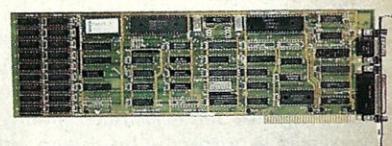
August 31: Lancaster PA. Red Rose Computerfest, Gurnsey Sales Pavilion, on Rt 30 East at Rt 896, run by Red Rose Repeater Assoc., Box 5029, Lancaster PA 17601. 

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The C Forum

by Don Libes

To advance from a novice to an experienced (but not necessarily expert) C programmer, one must be familiar with *casts* (also referred to as *coercions* or *conversions*). Grizzled C programmers know when to use them or avoid their use through good declarations. Beginning C programmers stumble into them, or sometimes avoid them through use of lucky declarations that may fail mysteriously when their program is ported to another computer.

Intuitively, a cast converts one type to another. The syntax of a cast is a type name in parentheses followed by the expression to be cast. For example, to produce a null character pointer, zero is cast as follows:

```
(char *)0
```

To paraphrase K&R (p.42), "a cast has the same effect as an assignment to a variable of the casted type." Internally, this means that a value's bit patterns may potentially change due to a cast. Some casts actually increase or decrease the number of bits used in representing the value.

If you don't want the bit patterns to change, you probably want to use a union. A practical example of this is the problem of comparing an IEEE-style floating point number against infinity. Since infinity is represented as a specific bit pattern rather than a number, there is no way to specify infinity in the natural notation of the type. One solution is to declare a union of a float and an integer long enough to store the infinity bit value, and then use the integer type when testing for infinity.

GENERAL GUIDELINES

If you find yourself always casting a variable before using it, you should probably re-examine your declaration, and ask yourself why it isn't declared as the casted type to begin with. In general, casts tend to disappear when variables are declared appropriately.

However, there are valid reasons for casting and I will discuss the major ones.

POINTER CONVERSIONS

The first one I want to get out of the way is the NULL problem.

```
#define NULL 0
```

```
char *broiled = NULL;
```

The C code above correctly assigns *broiled* to be a null pointer. This is because

Not Cast In Concrete

assignment implicitly converts the right-hand side to the type on the left-hand side. However, such conversions do not take place during function calls. Because of that, the following statement is incorrect.

```
function_takes_pointer_arg(NULL);
```

There are two problems with this statement. They stem from the fact that C does not check function calls against function definitions, so that this statement will have the compiler place an int zero on the stack.

The first problem is that the size of the pointer that the function expects may be different than the space required to hold an int. If the pointer is larger, extra bits accessed will have garbage values in them. If smaller, following arguments will not be accessed correctly. Redefining NULL as, say, (char *)0 or 0L, is not correct either since pointers of different types are not guaranteed to be the same size.

The second problem is that the NULL pointer may use a non-zero bit representation. Then, even if sizeof(pointer) == sizeof(int), the values won't match, unless C does the conversion. The cast will do this conversion correctly. (Conversely, casting a null pointer to an int is defined to return the integer 0.)

If you remember only one thing from this column, let it be the following: *Passing NULL as a pointer argument ALWAYS requires a cast.*

Two functions that invariably require casts are malloc() and free(). malloc() returns space guaranteed to be alignable to any type, but is declared as returning (char *). Just as the results of malloc() are almost always cast, similarly the argument to free() should be cast back to (char *).

Because of malloc()'s guarantee, it is acceptable to recast it to any pointer type. However, recasting of arbitrary pointers may lose information, depending on a machine's memory alignment rules. Even worse is what happens if you explicitly violate memory alignment restrictions. I unthinkingly did this while writing a program on a Motorola 68000. I was reading

variably-sized objects out of a buffer that I was managing myself. Occasionally I would get a bus fault while reading a two-byte integer. The code looked something like:

```
char *bufptr = buffer;  
  
2_byte_integer = *(int *)bufptr; /* ok */  
bufptr += 17;  
2_byte_integer = *(int *)bufptr; /* bus fault! */
```

The bus fault would occur whenever bufptr was odd. This condition was set up because there was no padding between elements in the buffer and some of the elements were an odd-number of bytes in length. The 68000 requires word loads and stores to be aligned on even-byte boundaries, and I was violating this, hence the bus fault.

Various things combined to mislead me, including 1) porting it to a VAX (which doesn't have word-store alignment restrictions) causing the problem to *disappear*; and 2) the debugger I was using cleverly faked the odd-address access and executed the request by doing two loads without telling me that!

Remember that when you cast a pointer, you are assuming responsibility for pointer compatibility.

FUNCTION CASTING

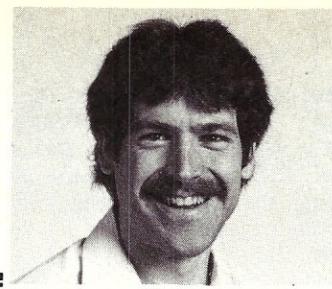
A special type of pointer casting is that of functions (which are treated as pointers). While function casting is rather unusual, a common enough cast is the following (extracted from the include file "signal.h" on all UNIX systems):

```
#define BADSIG (int (*)())-1
```

This definition of BADSIG coerces the type of -1 to be a *pointer to a function returning an int*. It's hard to imagine what -1 might do if called as a function. In fact, it is never actually called. -1 is only cast that way so that it can be checked as a return value against signal(), which is defined to return, you guessed it, a pointer to a function returning an int. What signal() is telling you when it returns a -1, is that you have handed it a *bad signal*, hence the name *BADSIG*.

ARITHMETIC CONVERSIONS

More typical uses of casts appear in arithmetic expressions (which includes character manipulation). The most common reason is needing to use a library call like sqrt() which is defined for doubles, but you have an int. In that case, the following suffices.



```
double sqrt();
int x, y;
x = (int)sqrt((double)y);
```

Here we have cast twice, first to promote *y* to the type required by *sqrt()*, and second to convert the double returned by *sqrt()* to an *int*. Notice that the second cast was, in effect, a truncation (or *demotion*) from a float to an *int* and accuracy was lost. Sometimes this is exactly what is wanted. Sometimes this is an error, since the double can store much larger numbers than the *int*.

CASTS TO AVOID SIGN PROPAGATION

Operations that propagate the sign bit can be rectified by casting from a signed to an unsigned type. For example, storing a signed character with the high bit on into an *int* variable will result in a negative value. Similarly, shifting signed *ints* can propagate sign bits.

In both cases, you can avoid this by either specifically declaring your variables as *unsigned*, or casting them as *(unsigned ...)* in expressions. Be especially aware, that some compilers treat chars as signed unless they are explicitly declared *unsigned*. Arbitrarily declaring all chars (and or any other types) *unsigned* is a mistake, however, because you may pay a significant performance penalty for using it instead of plain *char*.

CASTS TO AVOID NUMERIC OVERFLOW

It is occasionally useful to cast operands to larger types to avoid overflow. For example,

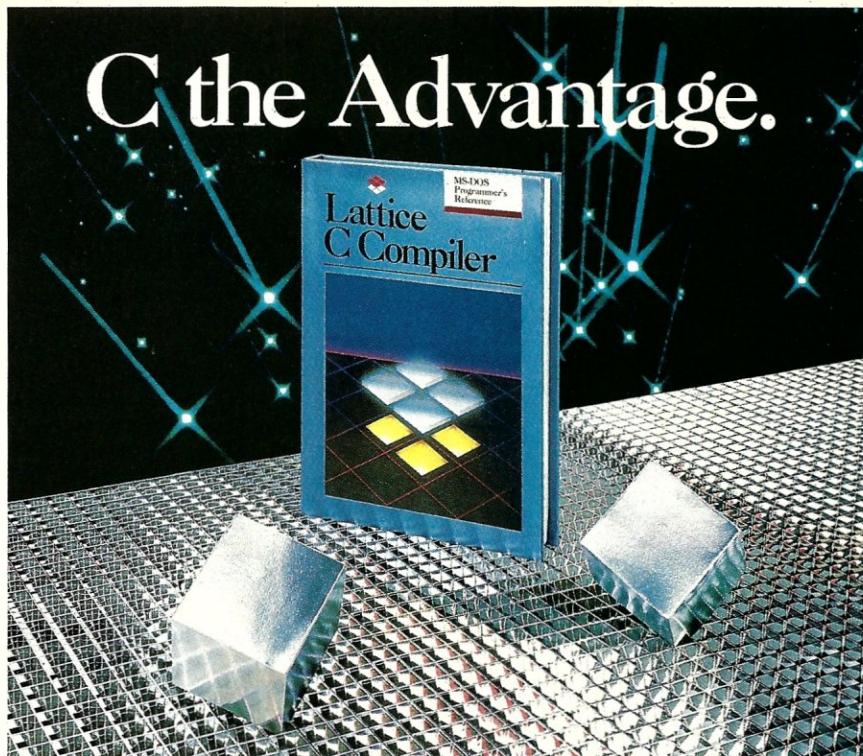
```
double z;
int x = MAXIMUM_INTEGER;
z = x + x;           /* overflow */
z = x + (double)x;  /* ok */
```

The first attempt at the addition fails because the addition of two *ints* is an *int*, which is not large enough for the result. The second attempt works because the addition of an *int* and a *double* is a *double* which is large enough for the result. Note, that this example doesn't depend on the result being assigned to a *double*. The result of the addition expression alone is the problem. You must always be careful to check whether your intermediate results need such a cast, even if you know that the final result fits.

DOCUMENTING A COERCION THAT WILL OCCUR ANYHOW

Occasionally, it is useful to use a cast as documentation that a conversion is going to take place anyway. This might not actually be clear otherwise.

In function calls, for example, chars are promoted to *ints*, and floats to *doubles*. Therefore, the following calls are equiv-



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alent even though they don't appear to be if you aren't familiar with the automatic promotion of arguments in C function calls. (It was certainly a surprise to me, when I first heard it!)

```
float f = 522.9347;
char c = 'Z';
function(f,c);
function((double)f,(int)c);
```

Certain other operations also cause automatic conversions, which are occasionally usefully pointed out by putting in redundant casts. These include returning values from functions, assignment, some miscellaneous arithmetic and logical operations.

CASTING TO VOID

Any value may be cast to *(void)*. Normally, this is only used to state that you are discarding a return value of a function.

For example, if you believe the rule that *if you can't handle an error, you shouldn't be checking for it*, this might appear as,

```
(void)fprintf(stderr,"uh oh...");
```

After all, if this fails, what should the program do?

Don Libes is a computer scientist working in the Washington DC area. He works on artificial intelligence in robot control systems.

there is mail.....



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SOLVING THE DISPLAY MEMORY MYSTERY

Dear Sol,

I recently had quite a surprise which might interest you. I had written a PC screen intensive benchmark, which a V20 microprocessor should have been able to complete in roughly half the time of a standard 8088. Actual measurements were quite disappointing, showing little improvement (5.7 seconds for the V20 versus roughly 8 for the 8088). Confused, I went back to the instruction set specifications for both processors and counted clock cycles. I discovered two things: 1) more than 98% of the time was being spent in a single (gigantic) block move of screen memory which scrolled the screen from right to left, and 2) not only should the V20 have been twice as fast, but it should have completed the benchmark in roughly 2 seconds vs. 4 for the 8088.

Thinking that perhaps someone was fudging their instruction timings, it occurred to me that although the actual times were way off, the difference between the two was almost exactly the calculated 2 seconds (8 vs. 5.7). Maybe time was being lost somewhere. Although the program was designed to handle a graphics display, just as a lark, I redirected the program to the monochrome screen and retimed it. Amazingly I got a time of 4.2 seconds! I then redirected the program to a nonexistent screen at 8000:0, and measured 2.4 seconds, very close to the calculated times.

Could the display memory be holding the CPU off? A check of the IBM Tech Ref Manual showed that the motherboard has wait state hardware and that it is tied to a signal coming from the video cards called I/O CMPLT. Using the NEC figure of 8 clock cycles per byte of block move, I inferred from the timings that the CPU is being held off of screen memory an average of 6 clock cycles per access in the

monochrome, and 11 clock cycles per move in the graphics card. But a block move involves two memory accesses per cycle (a read followed by a write). Does that mean that our figures are 2 times too high for a single fetch? Rerunning a similar benchmark with the MOVS replaced with a STOS, which only performs a single memory fetch per cycle, results in wait states of 6 and 12, almost exactly the same.

What seems to be happening is that the video card only allows the CPU access to video memory for short periods of time: longer than it takes for a MOVS to make a single read and write cycle, but shorter than it takes for the MOVS or STOS to come around again with the next transfer. During this time the CPU has completely unhindered access to display memory (no wait states). It then holds the CPU completely off of memory for 6 clock cycles in the monochrome card and 12 in the CG card (independent measurement indicate 10 cycles in the EGA), presumably while the CRT controller reads up the next block of pixels/characters to display. Turning the CRT controller chip off would probably result in the number of wait states going to zero for both cards, but that would result in screen flicker.

Stephan R. Davis

We trust that you will recognize the above letter writer's name. Randy has authored several articles in M/SJ, including the two-part series on the NEC V20 chip. Thanks for the info Randy! Keep the tidbits coming.

C-DEBUGGER CRITERIA

Dear Sol,

I think Jonathan Sachs missed the boat in his review of C Source-Level Debuggers by not mentioning what is perhaps the most important criterion for getting one: does the debugger allow access to all variables within a program, external static, internal static, local (or automatic as some people call them), as well as global. By access, I mean that all variables should be allowed to be viewed by a fairly simple naming scheme, not by some weird convention which requires the debugger (human) to figure out offsets from the stack. Except when I am interfacing assembler with C and must know how to

pick up variables being passed and to return a value, I do not want to worry about where off the stack things are, either in my program or debugging.

I know the Desmet debugger works admirably in this area, having used it on both CP/M-86 AND MS-DOS. No mention is made in the article at all about this area and issue. A C source level debugger that does not allow me easy access to all variables, especially local, is for me severely crippled if not almost completely worthless. That is why no one where I work (I'm a contract programmer) uses C-Sprite with the Lattice C compiler. I mentioned this deficiency to Lattice at Comdex in Las Vegas, but doubt they care too much. I care however and wouldn't waste my money on a source level debugger otherwise. I feel this should definitely have been mentioned in your article by Mr. Sachs.

Thanks,
Edward Diener

I agree completely with Mr. Diener's statement that a source level debugger should give access to all variables by name including locals and statics. I consider that to be part of the definition not only of a source level debugger, but of a symbolic debugger as well. All of the products reviewed could do so.

I did not mention this criterion because I considered it so basic and so obvious that there was no need. In the light of Mr. Diener's response, I regret that I was not more explicit.

Jonathan Sachs

GENERIC MS-DOS SOFTWARE

Dear M/SJ:

It was not fair to dismiss Mr. Kasper's letter (Vol.2 No.2) concerning generic MS-DOS software saying that all you need is IBM-PC compatible video, keyboard, and disk hardware.

MS-DOS is evolving into a useful operating system with its support of device drivers and wide range of DOS functions. But, if you want to build a system where the standard input and output device is through a serial port, then you lose out on many applications.

Neither the software mass merchandiser, nor the software companies want to mess with such systems, so I think you could be of service if you could keep a list of truly MS-DOS generic products. In your Publishers' Report of the same issue, you say you want to cover topics of special interest to advanced users. I think this would fit in your charter.

Here is some software you can add to this list:

1) CompuView (v1.4, \$150) or Vedit+(v2.32, \$225) and their Vspell and Vprint add-ons.

- 2) Micropro still has a generic version of Wordstar.
- 3) Cosmos has a version of their Pick-oriented Revelation database package.
- 4) Raima offers their db_Vista with source that is or can be made generic.

5) Lattice compilers offer very good separation of MS-DOS vs. PC-DOS functions in their library and their compiler is not PC-DOS specific.

6) Plink86 is an excellent linkage editor that runs MS-DOS. Their debugger, PfixPlus, fails.

Please reconsider your position and help in the support of these specialized system applications. Thank you for your time and keep up the good work.

Robert Allen
Garland, TX

DYNABYTE HELP NEEDED

We have a Dynabyte system and are in need of help; Dynabyte is *closed* and no service is available locally. Using the octaport board, we frequently experience having the data to any terminal (using 4), or to the printer, slow down to a snail's pace. When we reboot it's fine for a short time. When we Dynasys and take the octaport board out of the system (still on bus), everything works fine (2 term + parallel port). The octaport board has been replaced. Some say it may be the motherboard, any ideas?

Charles Baker
Associated Marketing Consultants
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FROM A NEW CP/M+ USER

Dear Bob,

You asked your readers what they are interested in. I recently started working with CP/M Plus and am interested in all the information I can get on it. I was a mainframe computer programmer for many years, but when I decided to buy one of my own, I went the inexpensive route and bought a Commodore 64. I recently upgraded to a Commodore 128 because it has a better CP/M package. I only found two books in the Wash D.C. bookstores on CP/M Plus. The documentation and BIOS source code Commodore sent me helped. CP/M on the C-128 only handles Commodore printers but not normal ASCII printers. I had to modify the printer driver to use the print capabilities of my Panasonic KX-1091. Commodore is supposedly releasing a new version of CP/M to satisfy customer complaints. I found out from Digital Research that the documentation for MAC, RMAC and LINK-80 is not part of the CP/M Plus documentation. I finally got a copy of it

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when I bought a copy of PL/I-80. The local computer store copied the disks from 8" to 5 1/4" disk format for me. I'm now interested in modifying CP/M to optimize the directory and disk buffers for my configuration. The buffers in bank 0 do seem to speed up the disk access in some situations. I have one fast double sided drive (1571 410K) and one slow single sided drive (1541 170K). Putting all files on the fast drive is the fastest configuration. Using both drives with some files on each drive is the next fastest. Using the fast drive as both drive A and virtual drive E is the slowest configuration. In defining the keyboard characters, Commodore used some control key values to generate some ASCII characters not on the keyboard (i.e. ^ = is ~, ^ : is {, and ^ ; is }). This is a problem for some people who want to use some of the rare control key values. Com-

modore's version of CP/M allows the keys to be redefined. Since ^9 and ^0 on the numeric keypad does not have any values assigned, I'm thinking of redefining them. CP/M Plus seems to have addressed many of the problems with CP/M 2.2. I like the quick warm boot and the ability of typing a series of commands on one line so batch files are not necessary in many cases. BIOS calls are a problem with CP/M Plus, but a lot of software that depend on BIOS calls is being modified to run under CP/M Plus. I'm trying to get copies of Dr. Dobbs Journal that had articles on CP/M Plus since not much literature is available on CP/M Plus.

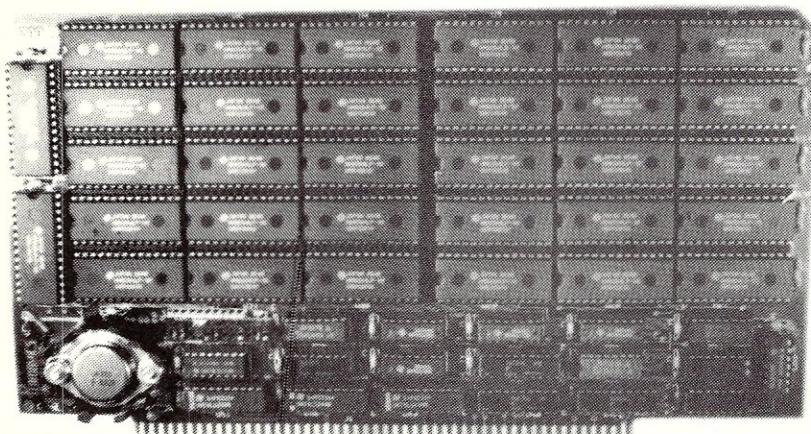
Another of my interests is computer languages, and this is what got me involved with CP/M in the first place. I bought the MIX C compiler, the MIX *continued on page 26*

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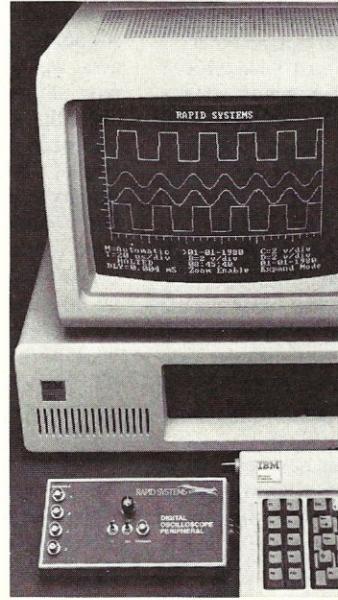
Powerful test and measurement equipment is as close as your personal computer for only a few hundred dollars.

DIGITAL OSCILLOSCOPE PERIPHERAL

For IBM, IBM compatible, Apple and Commodore personal computers. The peripheral hardware is contained in a compact 7.5" x 4" x 1.2" rugged ABS package that attaches to the computer via a ribbon cable and interface card. The digital oscilloscope software turns the personal computer into a versatile 4-channel digital oscilloscope.

Major features:

- Sampling rates to 2 MHZ.
- Variable gain: 1.6v to 320v p-p.
- Resolution to 6.25 mV.
- 8-bit A/D conversion.
- Simple menu driven turn key operation from the keyboard.
- Multiple mode triggering.
- Enhanced graphics display.
- Diode protected inputs to 300 v.
- Storage/Retrieval of waveforms.

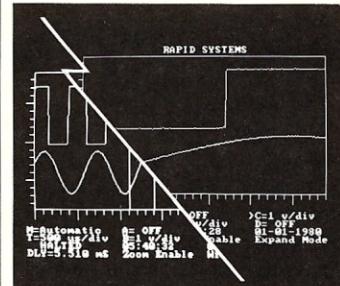


Rapid Systems Digital Oscilloscope Peripheral.

ENHANCED DIGITAL OSCILLOSCOPE PERIPHERAL

The enhanced digital oscilloscope is a software enhanced digital scope. The major features of this unit are:

- Zoom mode.
- Active scrolling of the waveform.
- Transfer data to 123/spreadsheets, dbIII files, or spectrum analyzer.
- Assembly language speed.
- Help file.
- Printer drivers.

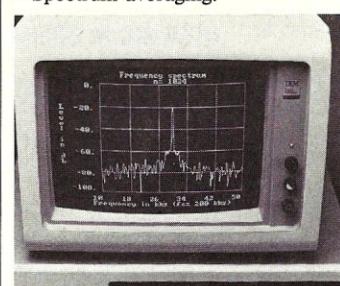


Zoom Mode of Enhanced Digital Oscilloscope Peripheral.

SPECTRUM ANALYZER PERIPHERAL

The Spectrum Analyzer Peripheral converts your PC into an instrument that characterizes an electrical signal for its frequency content. The peripheral uses the Fast Fourier Transform (FFT) in software to compute the signal spectrum. Major features:

- 2 MHZ digital scope software included free.
- Sampling rates to 500 kHz.
- Menu driven operation.
- Store/Retrieve/Print modes.
- Amplitude versus Frequency display using enhanced graphics.
- Hardware and Software triggering.
- FFT sizes: 16 to 1024 points.
- Frequency/amplitude cursor.
- Spectrum averaging.



Rapid Systems Spectrum Analyzer Peripheral.

DATA LOGGER PERIPHERAL

The Data Logger Peripheral allows the IBM or compatible personal computers to be used as versatile 4-channel data logging systems. The peripheral provides continuous measurement of up to four channels of data at a user selectable rate, and the data may be put out to hard disk or floppy. The number of data points to be taken is selectable by time or number of samples. Additionally, Start may be driven by either time and/or event (an internal or external trigger).

Rapid Systems Data-Logger Help Menu	
(A)	F1 - Display this Help Menu (Alt-F1 for Page 2)
(F2)	Select Sample Rate ..Current Value is 1.0 Seconds/Sample
(F3)	Select & Display Channel A Gain ..Current Setting +/- 8.0 Volts
(F4)	Select & Display Channel B Gain ..Current Setting +/- 8.0 Volts
(F5)	Select & Display Channel C Gain ..Current Setting +/- 8.0 Volts
(F6)	Select & Display Channel D Gain ..Current Setting +/- 16.0 Volts
(F7)	Convert Logged Data to Spreadsheet Format
(F8)	Convert Logged Data to Database Format
(F9)	Input Label for Screen Display
(F10)	Select Save Parameters or Redisplay Saved Data
	Select Function, CR, or Esc

Help menu from Data Logger Peripheral display.

Major features:

- 8-bit A/D conversion.
- Diode protection on all inputs.
- Sampling rates from .1 second to 999.9 seconds or event driven.
- Simple menu driven operation from the PC keyboard.
- Graphics display using 160x48 pixels for data display and data windows for parameter selection.
- Storage/retrieval of data on disk.
- Strip Chart printing with graphics printer.
- User selectable display headings.
- Automatic scrolling of a displayed waveform.
- Data reduction utility source and object code included!



Display from Data Acquisition Peripheral.

DATA ACQUISITION PERIPHERAL

The data acquisition peripheral allows the user to customize the PC for a specific data acquisition application. This unit provides a high speed, easy-to-use software interface for direct data access and control of the hardware. The User Definable Interface software (UDI) included with the peripheral provides assembly language subroutines dedicated to the control and acquisition of data from the hardware.

Major features:

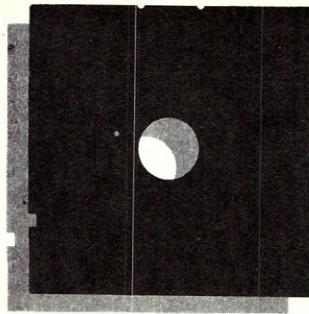
- Digital oscilloscope software included free.
- Sampling rates to 2 MHZ.
- Data acquisition setup utility.
- Data transfer utility.
- Selectable gain/sampling rate.
- Trigger mode selection.

*Prices are for IBM compatible peripherals. Other models cost less. Additional software and accessories available.

For your copy of the new Rapid Systems Test and Measurement Peripherals catalog, to order, or for further information, call or write Rapid Systems, 755 N. Northlake Way, Seattle, WA 98103. (206) 547-8311. Telex: 265017UR.

RAPID SYSTEMS





In the SIG/M Public Domain

by Stephen M. Leon



If I could make three wishes of programs I would like to see contributed to the public domain, what would I pick? That was the question Hank Kee posed the other day. I have been pondering the answer since then.

Let's face reality, you probably cannot do, in the present CP/M-80 environment, what you can do in either CP/M-86 or PC-DOS. But do you really have to do most of those things? The answer, sadly, is yes!

My CompuPro system has 512K. One 256K Ram-22 board for the machine cost me as much as a 640K loaded PC clone now costs. But, when I run Concurrent on the CompuPro I effectively have four separate computers and can switch back and forth between them. Sure, when I run CP/M 80 on the CompuPro, all that extra memory becomes an M-Drive ram disk...but so what. For less than \$400 I added a 2 meg JRAM-3 to the PC, and now have one heck of a ram disk. What is to become of all those CP/M-80 machines is the area of my wishes.

What heads my wish list? CP/M+ never caught on because Rich Conn's ZCPR brought to CP/M just about everything that Plus added. Well just about everything. Heading the wish list is ZCPR4. The man who has kept CP/M alive long after it should have been six feet under is about the only person I can think of who might come up with an easy way to increase the memory of CP/M-80 and, at the same time, add some type of concurrency. Included would be something akin to the Intel EMS specification that would allow the ZCPR utilities and other programs to be parked and swapped to a ram drive...kind of like the way DESQview does it on the PC.

No way this can come as a commercial product either. If it is to be made available to all, it's going to have to be the last gasp of the CP/M hacker fraternity. It isn't really that hard to do...I know someone who has already modified his CP/M 2.2 BIOS to do most of this, so how about it Rich?

The second item on the list also relates to Rich Conn. One of the things that has expedited the expansion of the PC-DOS world is the availability of free or cheap

applications software. Rich is doing a great deal of work on the Department of Defense ADA library. I understand from him that the DOD ADA library contains all sorts of applications software. All of it is available for free with a *big but*. The *but* is that there is really nothing available to compile ADA on a CP/M machine. There is an ADA subset, Little Ada, on Volume 92, which could serve as a starting point for a full compiler. Wish two then is for someone to write and donate a full ADA compiler to the SIG/M library.

The last item on the wish list is also well within the realm of possibility. There is software now that can do some of it, but I would like to see someone put it together as a complete public domain package. The program: a way to run a CP/M machine off a serial port of a PC as a second console for the PC with full emulation of the PC screen and keyboard and without a significant speed loss on either machine.

HOW SIG/M OPERATES

Time to stop dreaming and go back to the world of reality. Micro/Systems Journal generates a lot of SIG/M mail. We especially appreciate the software donations that are coming in. Please keep them up. We also have some complaints, with the most common one being "why does it take so much time for SIG/M to ship an order?"

First, let me explain just what SIG/M is. Legally, it is a user group of the Amateur Computer Group of New Jersey. As a practical matter, it is a not-for-profit cooperative effort by people throughout the world. It is strictly a volunteer organization. Dave Wrobel is the SIG/M chairman. Dave Raibert is the Treasurer. As Disk Editor, I review the contributions that come in, reject some, accept some, prod people to write programs where we think a need exists, and then organize them into volumes of approximately 230K each. I have the fun part of the job, sort of a kid with free run in the candy shop.

We normally date our new releases as of the date of our monthly SIG/M meeting (usually the third Friday of the month). If all has gone well, some two weeks before the meeting, we prepare master copies of

Steve Leon is the SIG/M Disk Editor. In other words, he is the person who assembles, complies, and edits all of the SIG/M public domain software disks. Thus, he speaks with the greatest authority as to what is going on in the SIG/M public domain software area.

the new volumes to Bob Todd, who is in charge of SIG/M distribution. At the same time we air mail copies to selected foreign distribution points (England, Japan, Australia and Mexico). Bob makes additional copies of the disks and starts them off on a series of circuits that reach all of the US and Canadian distribution points. We also prepare the seed copies for mail order distribution, and make copies for the ACGNJ and NYACC BBS systems and CompuServe. Thus, if all goes well, the software is available throughout the worldwide network by the release date.

SIG/M mail order distribution is handled by Glen Dusch. Glen picks up the mail at the SIG/M box (Box 97, Iselin NJ 08830) and sees to it that mail orders are filled as soon as possible. It normally takes about a month from the time he receives an order at Box 97 to the time the UPS man delivers it to the user. Up to now, SIG/M itself only supported 8" SSSD format disks. However, we have started an experiment and are now shipping all SIG/M volumes on 5" disks that can be written on the PC using Uniform, (just about all formats except Apple, Commodore 64, or any of the high density formats). These disks are \$7.00 per volume. However, for formats that have less than 240K per volume (usually SSSD formats), there will be an additional \$2.00 charge.

We encourage users to get their software from places other than SIG/M at Box 97. We do our best to get the new volumes out to the network so that you can get them locally. Many club user groups also make them available for a nominal copying charge (usually \$1/volume) with the user providing the formatted disk.

Delays in shipping SIG/M orders are usually caused by such factors as waiting

for catalogs to be printed, everyone being tied up with the Trenton Computer Festival, Glen going on vacation, etc. And, when you add complications to a SIG/M order, such as requesting information or asking us to pick volumes for you, or asking for one program from each of 17 disks or not being sure of a volume number, all too often the order winds up on a pile waiting for someone to stop over at Glen's place to answer some mail. A few years ago the SIG/M Treasurer blew a fuse when he found a stack of stale checks for filled orders, so now Glen usually processes the checks early in the game.

The bottom line is: if your order isn't filled within a month, something is wrong and we want to know. Drop a note to SIG/M, Box 97, Iselin NJ 08830. Tell Glen what you ordered and when. If you want to complain to me and have me call up Glen, drop me a note at 200 Winston Drive, Cliffside Park, NJ 07010. Let us know if there is a problem. But don't be too harsh on us, because we do try, but even in an organization of volunteers, there is no excuse for doing a poor job.

NEW SIG/M RELEASES

In the last issue we introduced Volume 255 as the first of a number of new releases from the Japan User Group. We now have seven additional volumes and more are expected shortly.

Volumes 265 to 268 constitute a four volume General Activity Simulation Program (GASP). Written in Fortran with code for both CP/M and CP/M 86, this series is duck soup for the queuing crowd. Volume 268, in Fortran 80, is Statistical Distribution and Multiple Regression.

These programs are obviously geared to a specific area of user, but they do hold some general interest for all who are interested in the type of coding that is coming out of Japan. Some of the routines are quite interesting and readily adaptable by Fortran programmers. Aside from that, as someone who wound up writing a queuing routine for the student cafeteria as a term paper, you never know how you can adapt from the public domain to meet your specific needs.

There are a number of other statistical programs in the SIG/M library. These include a statistical analysis package in Pascal-Z on Volume 71 and statistics in North Star Basic on Volume 182. There is another simulation model on Volume 123.

I took another look at the program on Volume 123. It is a 47K file called ODMP.LBR. According to the program documentation it provides an operational environment similar to an Analog Computer using a block diagram approach and a second order Runge Kutta (modified Euler) integration algorithm. If you know what that means, you may be interested in the program.

What did come up in this review, and of general interest to all, is the difference between library utilities. Over the years LU (library utility) has been much improved. The NULU version does even more than just plain LU, but one important change in version 3 of LU is the addition of a CRC checklist in the file. If you have a library created by the old LU and you try to read it with the new LU, you will get a notation of a CRC error. Use the -L command to list the contents and you will see that all CRCs are 0. It does not mean that there is an error in the file. It means only that the library was created with the old LU. (I should also note that the LU86 we put on CP/M 86 disks with library files also does not support CRC.) If you want to add the CRC values to an old library, merely open up the file with LU301 (command -O). Then reorganize (command -R) with the same number of entries. Before you do this, however, I suggest you verify the CRC of the entire library with the CRC in the catalog file for the volume. That way you know that the file has started out with the proper CRC.

On the subject of CRC, sometimes a change in format produces a change in CRC value. The catalog files on SIG/M volumes are automatically created by John Rath's CRCBUILD. The CRC values for each program are stored in the catalog. Glen tells me that sometimes when he transfers a disk from standard 8" to one of the 5" formats the CRC value of the file changes because of the way the format handles such things as blank spaces. I have tried to duplicate this, but so far with no luck. Therefore, if you have a bad CRC on a 5" disk, you may still have a good program.

Someone called the other day looking for a program to unprotect an MBASIC file. (The easiest way to find something in the library is to use the catalog volume, Volume 0 and do a string search.) Anyway, if you have the same problem, unprotect for MBASIC is on Volume 52. MBASIC users may also be interested in VMAP on Volume 40, an MBASIC variable mapper, and MXREF on Volume 78, an MBASIC cross reference utility.

SIG/M Volumes are available on 8" SSSD Disks for \$6 each (\$9 foreign) from SIG/M, Box 97, Iselin, NJ 08830. Volumes may also be ordered in most 5" formats (other than Apple, Commodore 64 or high density format) for \$7 each (\$10 foreign). There is an additional charge of \$2 for formats which require more than one disk to hold a 240K volume (such as SSSD formats). Printed catalogs are \$3 each (\$4 foreign). Disks in a variety of formats may also be obtained through the worldwide SIG/M distribution network. The distributor list is included with the printed catalog. A disk version of the catalog (Volume 00) is available for \$6. It also contains the distribution list. Many bulle-

tin boards have the software for download-ing and most new releases are available on the CP/M Sig on Compuserve. μ

NEW PUBLIC DOMAIN RELEASES

Volume 265

GASP (General Activity Simulation Program) from Japan User Group Volume 7 (Vol 1 of 4). Documentation and CP-M 80 Version

Volume 266

GASP (General Activity Simulation Program) from Japan User Group Volume 8 (Vol 2 of 4). CP-M 86 (SSS-Fortran or ai-Fortran) Version and Source Programs of GASP Subroutines

Volume 267

GASP (General Activity Simulation Program) from Japan User Group Volume 9 (Vol 3 of 4). Executable GASP Code for CP-M 86

Volume 268

GASP (General Activity Simulation Program) from Japan User Group Volume 10 (Vol 4 of 4). Extended Version of GASP II for F80 & F86

Volume 269

Statistical Distribution and Multiple Regression with Interval Estimation for Fortran-80 from Japan User Group Volume 12

Volume 270

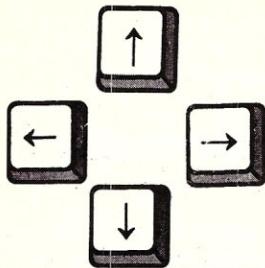
Turbo Pascal Programming From Japan & Abstracts from various Japan User Group Volumes

Volume 271

C Programs from Japan & Abstracts from Japan User Group Vols 19 & 20

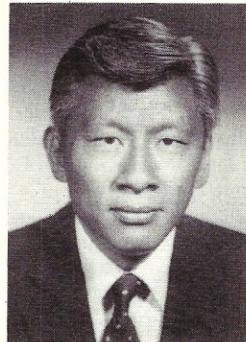
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PC/Blue Report

by Hank Kee



There are now 200 volumes in the PC/Blue Public Domain Software Library. All due to the efforts of many unsung heroes who contributed their time and talent to develop these programs and make them available as either public domain or user-supported software. The library continues to grow dramatically.

The PC/Blue library represents a very rich source of software for the PC and compatibles. This software collection, over the past four years, has enabled the new user to build a basic software library at minimal cost. Many computer clubs also use the library to attract members as well and cover operating expenses by charging a nominal amount for copying (typically \$1 to \$2 per volume) for copying.

I have often been asked, how good are the programs? They are, for the most part, very good. Some of the programs have no commercial equivalent and cannot be found anywhere else. Public domain and user-supported programs were made available through this medium of distribution because normal outlets for aspiring software entrepreneurs no longer exist.

How would one go about selecting from this vast repertoire of software? I will try to point to, what I feel are, the best of the collectibles, in terms of a "hacker's pack", a "businessman's pack", and a "fun pack". I have assembled each pack into a ten volume set. The number of volumes in a set is arbitrary. A box of diskettes normally contain ten.

Fundamental to all the packs, is a good modem communication package. Hackers, game enthusiasts, and business users alike need to communicate with other computer systems. *QModem* is clearly the most popular of them all. It is easy to use, functionally comprehensive, well maintained and richly documented. An excellent rival to *QModem* is *ProComm*. *ProComm* is very similar to *QModem* in basic function but has many more features.

THE HACKER'S PACK

The components for the Hacker's Pack, should include good program development and artificial intelligence languages, an expert based system shell, and tools for testing PC's. And, of course, what would a hacker be without CP/M?

Recommended Hacker's Pack

QModem (vol 191)/ProComm (vol 200)	modem communications
BBBS-PC (vol 198-199)	remote bulletin board system
LISP (vol 188)	Lisp interpreter
PD Prolog (vol 183)	language processor
Small C (vol 154)	original "small" C
CP/M 2.2 Emulator (vol 185)	CP/M 2.2 emulator for V20 chip
The Expert (vol 176)	expert system shell
PC-Write (vol 167)	word processor
PC Magazine Lab Series#1 (vol 135)	benchmark programs
PC Magazine Lab Series#2 (vol 179)	benchmark programs

THE BUSINESS PACK

The businessman needs his standard fare of word processing, spreadsheet and database management systems. Add to this some of the desktop management tools along with an investment record system and you have a pretty comprehensive generic business pack.

Editor's note: Hank Kee is the librarian for the PC/Blue public domain software library. He is the person who collects, assembles, and checks all the software issued by PC/Blue and then compiles and edits them into the released volumes.

Recommended Business Pack

QModem (vol 191)/ProComm (vol 200)	modem communications
PC-Calc (vol 141)	electronic spreadsheet
PC-Write (vol 167)	word processor
Personal Management (vol 133)	DeskMate/Partner
pBase (vol 168)	database management system
PC-DBMS (vol 131)	database management system
DOS Assistant (vol 162)	operating system support
TAM (vol 113)	financial monitoring system
Stock (vol 120)	investment record system
DBS-Kat (vol 197)	super diskette catalog system

THE FUN PACK

The fun pack is for those looking for something unusual. This should include graphics and some smart and slick graphic games to make up this spiffy set.

Recommended Fun Pack

QModem (vol 191)/ProComm (vol 200)	modem communications
WPK (vol 95)	word processor for kids
Present (vol 164)	slide presentation system
EScreens (vol 171)	create interactive screens
Origami (vol 132)	Japanese art of paper folding
3By5 (vol 125)	information management
GluDraw (vol 85)	line graphics system
DBS-Kat (vol 197)	super diskette catalog system
CaveQuest (vol 178)	dungeon/dragon graphics game
Striker (vol 190)	chopper graphics game

The recommended lists are, at best, personal preferences. There are many other well deserving software systems which could have easily added to the *recommended* lists. Software is organic. By that I mean that there will be continual changes. \square

NEW PC-BLUE RELEASES

The following are the new releases to the PC/Blue library:

Volume 188

LISP Interpreter by Marc Adler
NYWord version 1.2-word processor by Marc Adler

Volume 189

Color Graphics Adapter Games
One-Arm BANDIT, BlackJack-BJ, Poker, Rockets, Roulette, Stock & SubChase

Volume 190

Color Graphics Adapter Games
Striker, Kong, Golf & Monopoly

Volume 191

QModem version 2.0E - modem communications by John Friel III

Volume 192

ICON-high level language version 5
SNOBOL like programming language by Ralph E. Griswold
Small-C Interpreter version 1.3 by Bob Brodt

Volume 193

Colossus-remote bulletin board by Forbin Project/Dan Plunkett
QModemJr-modem communications by Forbin Project/John Friel III

Volume 194

Kermit version 2.28 - modem communications

Volume 195

EZ-FORMS - form generating program
PC-Font2 version 2.04
Epson printer utility

Volume 196

Nutrient-food analysis program

Volume 197

DBS-Kat version 1.3 - super capacity diskette cataloger by Applied Foresight Inc.

Volume 198-199

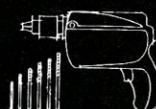
RBBS-PC version 14.1A - remote bulletin board system

Volume 200

ProComm version 2.3 - modem communications by Bruce Barkelew/Tom Smith

Copies of the PC/Blue printed software directory can be ordered from Micro/Systems Journal, Box 1192, Mountainside NJ 07092 (\$5 U.S., Canada & Mexico; \$7 foreign).

PC/Blue disks are available from the New York Amateur Computer Club, Inc., Box 106, Church Street Station, NY NY 10008. Price is \$7 per volume which includes media, postage, and handling. On Foreign orders, please add \$2 per disk.



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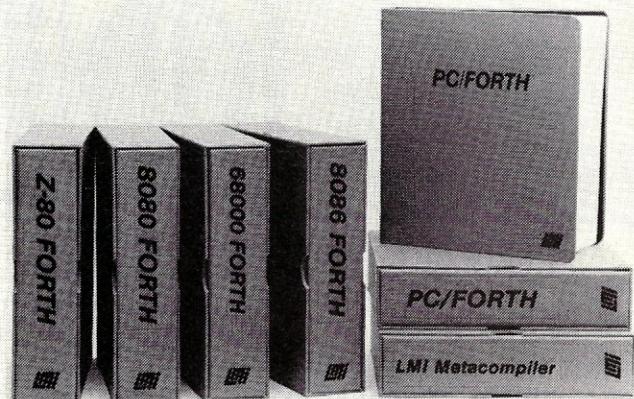
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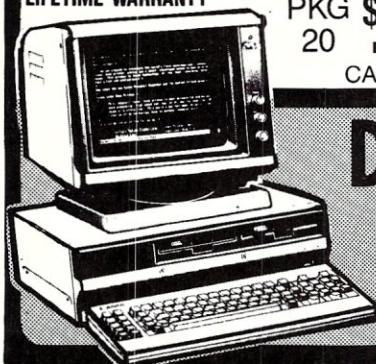
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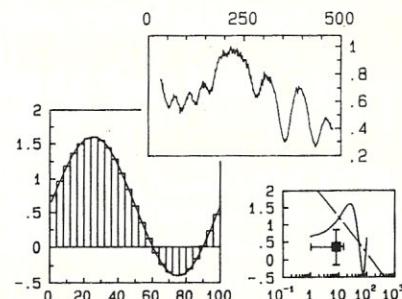
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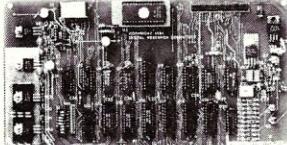
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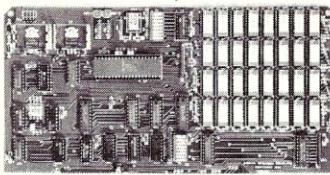
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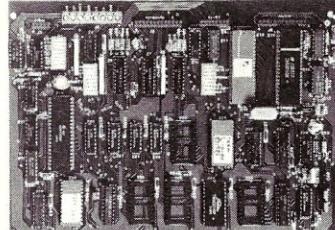
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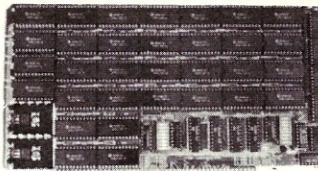
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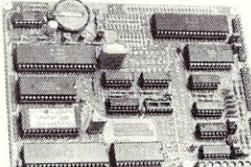
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Power to the PC!

by Stuart A. Jones

In my brief tenure as an IBM Compatible User Group Coordinator and general-purpose Personal Computer Maven, I have been surprised by how quickly my fellow users become dissatisfied with their computers' performance. A recurring topic at club meetings is how to wring the last millisecond out of a dBASE sort, a Lotus recalculation, or a Cobol compilation. As *Resident Expert* (of sorts), I usually get drawn into these discussions. This article represents a summary of the collective wisdom of various users, who have tried one or another of the gadgets and dodges described below in order to enhance the performance of their computer systems with varying degrees of success. IBM and third-party manufacturers have produced a dizzying array of products for PC enhancement. Many of these work as advertised, some better than advertised, and a few should be floated out to sea to feed silicon-loving marine organisms. My fellow users and I have sorted through these by trial and error. The discussion below will hopefully spare you, gentle reader, from the various trials and errors of our collective experience.

IS THIS UPGRADE NECESSARY?

Before embarking on a PC Enhancement Program, there are several questions you should ask yourself. First and foremost, you should determine whether you really *need* more performance. Apart from direct costs, there are potential problems with added unreliability (from either a flakey addition or an unexpected interaction between the add-on and existing hardware and software) as well as and potential incompatibility with current components. The *kid-in-a-candy-store* approach to enhancing PC's is a sure path to disaster. Therefore, a little *cost-benefit analysis* is in order.

There are a few general observations which can help you make the decision whether or not to upgrade:

1. If your pet PC is used for business, and you find yourself *hung up* doing necessary computer work in one of the ways described below, you *must* upgrade, since saving your valuable time will likely pay for the improvement in short order. In most major corporations, any purchase which pays for itself in one year is *mandatory*! This rule should be applied to PC's, as well

A Strategic Guide To Improving PC Performance

as everything else.

2. If your current frustration level with your PC's performance is such that you are often tempted to throw the bloody thing out the window, then an upgrade may well pay for itself by preserving your sanity.
3. If you find yourself frequently looking for excuses to use the PC/AT down the hall because you are weary of waiting for your PC to grind its way through the work, it's likely to be upgrade time.

Clearly, these criteria apply mainly to PC's which are being used for *serious* purposes. Unless your last name begins with *Rock* and ends with *feller* (in which case you can afford your own mainframe), it makes little sense to enhance a machine used mainly for fun and games. (Indeed, certain upgrades make game-playing impossible because of excessive execution speed or incompatibility with copy protection.) Obviously, also, if you are a *hacker*, whose joy in life is adding new stuff to his computer, this discussion doesn't apply. However, most PC users I know are using their machines for at least some work with economic impact, and therefore should pay attention to these issues.

WHERE'S THE HOLDUP?

If you decide your PC is indeed slowing you down intolerably, the next question is, what part of your computer system is the culprit? There are five common PC components which can cause performance problems, each of which causes a particular set of *symptoms*:

1. The CPU. If you are *CPU bound* you are spending too much time watching your PC *think* between keyboard inputs or disk accesses.
2. The disk. If you are *disk bound*, you spend too much time observing the little red lights on your disk drives and listening to grinding noises from disk-head movement.

3. The printer. You spend too much time waiting for hardcopy, not enough time computing.

4. The keyboard. At the end of each day, your fingers feel like they've run a marathon. However, be aware that a CPU-bound application may appear keyboard-bound if the computer spends too much time *thinking* between inputs.
5. The software. Your buddy across town performs the same size and type of spreadsheet analysis as you do, on a similarly-equipped PC, in half the time, using a different program.

For each of these hang-ups, there are specific cures, most of which are not worse than the disease. But before we examine solutions, there are two more issues which must be addressed: the size of your upgrade budget and how much technical support you have available.

The amount you are willing to spend will likely be determined by your initial cost-benefit analysis. If your application is critical, and the time-savings likely to be great, the sky may be the limit. Often, your budget will be set for you, hopefully by sympathetic financial executives (they tend to be heavy PC users, and will know whereof you speak). In smaller organizations, however, upgrade money may be tight, and your options therefore constrained.

The degree of technical support available may be critical in choosing your enhancements. Some upgrades can be managed by anyone capable of wielding a screwdriver; others require Peter Norton (or local equivalent thereof) standing at your elbow. Your available support may also determine the price you pay for improvements. If you have good in-house support, you can purchase almost anything you need by mail-order, knowing that the local experts can deal with potential problems. Otherwise, you may be better off buying from the nearest capable full-service dealer, paying a higher price, but being assured of assistance.

Now that we have explored these preliminaries, let us examine possible solutions for each of the five problem areas.

HELP FOR THE CPU BOUND USER

If you indeed need a PC which can compute faster, you should first ask yourself if you need a *new* machine altogether. At present, there are three

grades of PC mainframe available in the marketplace:

1. PC-class machines. These use an 8088 microprocessor chip, and run at a clock speed of 4.77 MHz. With a few exceptions, non-IBM examples tend to be 95%+ PC-compatible. Note that the IBM PC/XT, despite its hard disk, is a PC-class machine.

2. Intermediate-class machines. These typically use an 8086 or 80186 CPU chip, and run at 4.77 to 8 MHz. These tend to *think* 1.4 to 2.5 times as fast as a standard PC, and can still be very compatible, though some machines in this class (notably the Wang PC and Tandy 2000) are not very. Certain machines which use the 8088 chip and run at high clock speeds (up to 8 MHz, which gives 1.6 x PC performance) fit in this category. Some of these (notably the AT&T PC-6300 and certain *Turbo* clones) are bargains, costing slightly less than a standard PC.

3. AT-class machines. Using an 80286 microprocessor, these computers are typically only about 85% PC-compatible (though most business applications programs tend to run OK), but can compute 3 to 6 times as fast as a PC.

Upgrading your mainframe is technically simple, as long as you can be assured that the gadgets already plugged into your old PC will work with the new one. External gizmos—printers and modems, for example—are generally not a problem unless your current hardware uses non-standard cables. However, internal modems, memory expansion cards, and especially non-standard graphics, laboratory, and communications cards, may not operate properly in a different machine. Nonetheless, if you really need an AT-class machine, the cost of replacing existing add-ons may not be a significant deterrent.

If you are using an AT-class machine and are *still* CPU-bound, you should certainly ask yourself if your application(s) belong on a minicomputer instead! However, it may still be possible to enhance your computer's thinking speed by plugging in a clock crystal which makes it run at 8 or 10 MHz instead of the standard 6 MHz. (IBM's current version of ROM-BIOS precludes use of a higher-frequency clock crystal, but the clock crystal may work on earlier AT's, or AT-class machines from other manufacturers.)

If your calculations involve heavy use of *floating-point numbers* (e.g. spreadsheet, financial, scientific, or engineering applications), an 8087 or 80287 numerical-data-processing chip is a very desirable option as it is relatively cheap (\$100-300), easily installed, and causes

no software incompatibilities. However, your applications software *must* support use of the 8087/80287 in order for you to benefit from its installation. Also, be aware that the version and permitted clock speed of the numerical data processor chip must be matched to your computer. AT-class machines require the 80287; PC-class machines use the much cheaper 8087 or 8087-3; and intermediate-class machines which run at faster than 5 MHz require the 8087-2, whose price is likewise intermediate. Also, it pays to install a high-speed 80287 variant (a small circuit board that holds the chip plus a clock to drive it, all of which plugs into the 80287 socket) into a PC/AT, since the standard PC/AT drives the 80287 at a *slow* 3 MHz. MicroWay also produces this type of product; the one user I know who has one loves it.

If you need a CPU upgrade, and your budget is limited, a co-processor card may be your best option. This is a plug-in, PC-bus-compatible circuit board which holds a different and faster CPU chip (8086, 80186, or 80286), as well as special high-speed memory (usually 512 to 640 Kb) and support circuits. There are two varieties of PC-compatible co-processor cards. One requires that you remove the 8088 chip in your PC and plug in a header connector, in addition to installing the board in an available slot; the other just drops in to a slot. Boards using the *header* approach tend to be a bit more software compatible than the *drop ins*, but require some local technical assistance for installation. The *drop in* cards are easier to install, but require some software installation as well. However, the same software usually enables you to have your PC ignore the co-processor when you need 100% PC-compatibility. Prices for 8086- and 80186-based co-processor cards are dropping rapidly into the \$700 to 900 range. The 80286-based cards are still very expensive (typically more than \$2000) and therefore not as attractive. Common *header* cards are the MicroWay *Number Smasher* (which includes a high-speed 8087 chip) and the Univation card (which is similar to the *Number Smasher* and about the same price). The most common *drop in* card is the Orchid PC-Turbo Board, which is 80186-based, and about 90 to 95% PC-compatible. There are many other commercial products in this category, however, and new ones with better features are constantly being introduced.

HELP FOR THE DISK-BOUND USER

If you happen to be doing serious work with your PC, and are still using only diskettes for mass storage, RUN, don't walk, to the nearest appropriate supplier, and buy a hard-disk drive. Prices for Winchester hard drives have fallen so low, so fast, that it is ridiculous to be without

one, however, be aware of the hidden costs of a hard drive:

1. If you keep changeable data (e.g. inventories and correspondence) on the hard disk, you *must* establish a routine for copying this data to floppy disks (or use some sort of tape backup, if you can afford to) at frequent intervals. I have heard it said that the only difference between an expensive hard disk and a cheap one is that the expensive disk takes a little longer to break down! All Winchesters fail eventually, and when they do, all data on them is invariably lost. Some users I know keep only programs on their hard disk, and store all data on floppy disks.

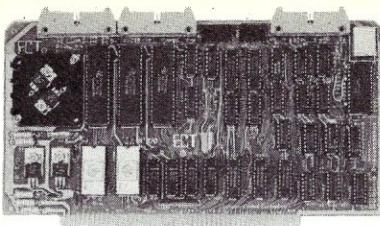
2. Since hard-disk failure is inevitable, you must plan at some point for replacement costs. Some users buy two hard drives of the same size, and use one as a backup, not unreasonable, since a second drive typically costs less than a tape drive.

3. If you are not planning to buy a tape drive along with your hard disk, you should invest in either FastBack or Bakup. These software products vastly improve on the pokey speed of the DOS *backup* command in transferring data to floppy disk. If backup is relatively painless, you will be less tempted to cheat (and potentially lose).

If you are using a PC or a clone (5 slots, 60-odd watt power supply), you should purchase an external hard disk drive, which typically costs about \$200 more, but which will not overburden (and possibly burn out) your computer's power supply. Even if you have a larger power supply, the external drive is easier to install (and replace when it breaks). Installing an internal drive may mean giving up one of your disk drives (making disk-copying painful), and requires some technical help. If you have an old IBM-PC with the 64 Kb motherboard (sold before February 1983), you may wish to try a ROM-BIOS upgrade (\$30 from IBM, if you can find one). This will enable you to start DOS from your hard disk. However, be aware that the ROM upgrade doesn't work with certain memory expansion boards and video-display cards. Having to *boot* from floppy disk is a minor inconvenience, but a significant one for less patient users.

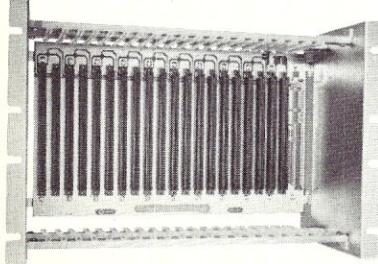
If you need a hard disk, have data that requires high security, and/or need the ultimate in convenient backup, consider an Iomega Bernoulli Box. This product stores 10 or 20 Mb of data on 8" cartridges which are very rugged, and has excellent hard-disk performance specifications as well. The only problem with this excellent add-on is its price, over \$3000 list for a two-drive subsystem. However, that's not much more expensive than a premium-grade 40-Mb Winchester sub-

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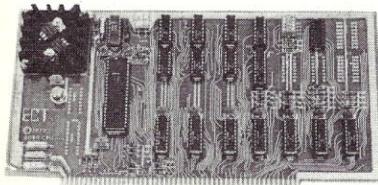
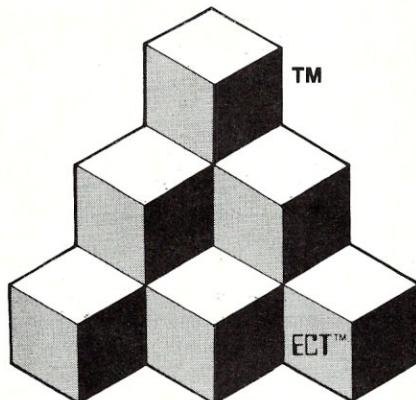
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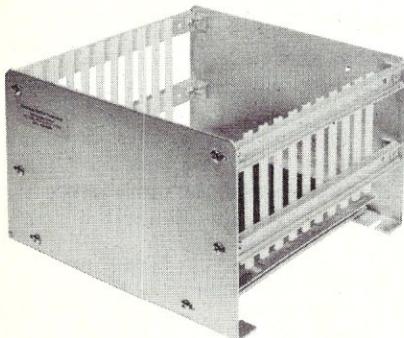


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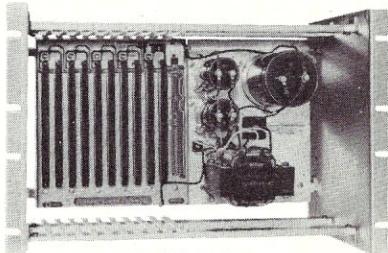
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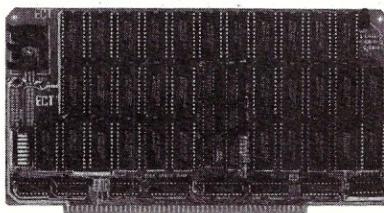
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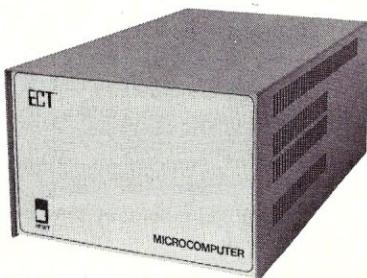
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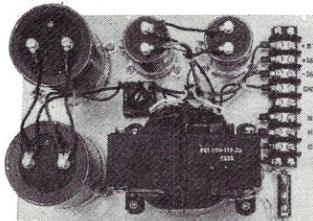


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Users who already have a hard disk and are still disk bound have two options: purchasing a higher-performance hard disk drive, or using one of the new high-capacity, memory-expansion boards to provide a large ramdisk. If your disk-binding problem involves sorting data bases, the latter possibility is both relatively inexpensive (under \$450 for 2 Mb from many sources) and simple to install and use (plug in the card and install the DOS-driver software). High-performance 5 1/4" hard disks (average access time is 40 msec. or less) are more expensive, but the data doesn't disappear when the power's shut off, like ramdisk. PC peripheral manufacturers have recently begun producing hard-disk controller cards using the SCSI (Small Computer Systems Interface) standard. Many different very high-performance 8" or 12" Winchester disk drives (average access time is less than 20 msec.) can therefore be connected to a PC, but at an expensive price (more than \$6000 for 80 Mb). These drives typically produce lots of heat and noise, and often are physically larger than the PC they're connected to.

HELP FOR THE PRINTER-BOUND USER

Very few users, in my experience, are truly printer-bound, in part because fast (160 cps or more) printers are so common, and also since the solutions discussed below are so inexpensive and widely known.

The two most common tactics used to avoid printer-binding are:

1. Buy a faster printer. The printer performance/price ratio has skyrocketed over the past three years. As an illustration, I just traded in a wide-carriage Epson MX-100 printer (November '82 vintage) for an FX-185 model from the same manufacturer. The new printer cost half as much, prints 2.5 times as fast, and has excellent near-letter-quality print built in as well. If you do a lot of printing and your printer is over 2 years old, you should at least check at the marketplace.

2. Employ a printer buffer. This may be done with either hardware or software. A hardware printer buffer is a small memory unit which plugs between your printer and the PC, and temporarily stores printout data until the printer is ready for it. A hardware buffer may be simulated by a small program which sets aside part of the PC's memory as temporary printout storage. Print-buffering programs (often called *spoolers*) usually stay resident in



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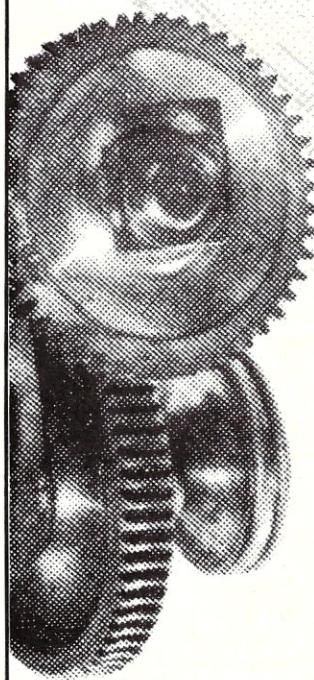
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continued from page 11

editor, ZBASIC, and the relocatable Z80 assembler from Mitek as well as the PL/I-80 compiler. So far, I'm happy with them because they seem to be complete implementations of the languages (except PL/I-80 but it has enough). I also ordered the Z80 debugger from Mitek. From the documentation, it seems to be a full screen debugger that is patterned after some of the full screen debuggers for the PC type computers. Mitek sent me the wrong disk, so I had to send it back for replacement. Borland let me upgrade the version of Turbo Pascal (2.0) that I ran on the C-64 to a version that runs on the C-128 as part of their upgrade to 3.0 plan. Currently, PL/I-80 is my favorite language because of the extensive capabilities built into it. However, very few magazine articles seem to be written on it. Strangely, some versions of computer languages available in Commodore's native operating system seem to be better than what is available in CP/M. Superforth-64 has the most extensive library of any version of Forth that I've seen. PROMAL is the only high-level language compiler that I've seen that generates object code that runs close to assembly language speed. I find the full version of COMAL is an interesting language. It was available in the US on the C-64 before it was available on other computers and operating systems. There is a version of Pascal (Super Pascal) on the C-64 that even though it does not do in memory compiles, it corrects some of the short-comings of Turbo Pascal. It allows passing of functions and procedures as parameters (this is useful to me for numerical analysis), it has a built-in assembler so procedures can be written in assembly language instead of imbedded machine language, and PUT GET standard NEW DISPOSE READ WRITE and an unrestricted GOTO are all implemented. When I was debugging programs in batch mode on mainframe computers, I found memory dumps very helpful especially when turn around was every four hours. When interactive programming became available, using display or print statements in programs became a popular method of debugging. This may still take time on difficult programs. One C language program took me several days to find the problem using print statements. Super Pascal has a useful option to provide a *post-mortem-dump* — a listing of the values of all the variables, a dump of the heap, and a trace-back of procedure calls and parameter stacks when a run time error occurs. I probably need to learn how to use a machine language debugger to track difficult high level language problems. Sometimes a dump is more useful than a trace.

The Commodore-128 will make an in-
continued on page 49

memory as *background* tasks, stealing CPU time to send data to the printer. The hardware buffer is preferable, since print-buffering software takes up memory space and CPU time, and may be incompatible with other programs. Also, the price of hardware buffers has fallen with the price of memory. A 64 Kb buffer (holding about 20 pages of printout data) can now be bought for less than \$150.

If your favorite PC applications involve a great deal of printing, and especially if other users in your organization use printers heavily, a laser printer may be very cost-effective. This type of printer is virtually silent, produces excellent letter-quality print (and in some cases graphics, too), prints 6-8 pages per minute, and is presently available for under \$3000 (graphics-capable printers cost much more, however). Laser printers can be shared, either via cable switches, or by using a low-cost PC-compatible as a printer-driver. (An expensive network is not necessary for printer-sharing. I personally prefer the *frisbee* method of print-serving: flip a floppy over to the print-PC.) Everyone I know who uses a laser printer is ECSTATIC, and the envy of us lesser mortals! A few laser-printer users are producing near-typeset quality newsletters, via special software which takes text files and formats them for the printer. Desktop publishing is quite a bit more expensive than plain laser-printing with typical hardware/software packages is in the \$12,000 range.

HELP FOR THE KEYBOARD BOUND USER

As mentioned earlier, it is uncommon for a PC-user to be truly keyboard-limited; complaints regarding slow keyboard response usually reflect a CPU-performance problem. However, there is a small but growing class of users who spend all day entering spreadsheet data, processing words, inputting inventory, thereby wearing their fingers out. There are a few products, all relatively inexpensive, which can make heavy keyboarding much easier.

The most obvious upgrade is a better keyboard. *Better*, in this case is relative; everybody has their own preference for keyboard *feel*, audible keystroke feedback, keyboard layout, etc. Word-processing users may consider learning how to use a keyboard with the Dvorak layout, after the inevitable adjustment period. Using such a keyboard reputedly improves throughput by 30 to 40%. If you want a Selectric layout and keyboard *feel*, no problem. Spreadsheet users can benefit from a keyboard with separate arrow and number keypads. Such replacement keyboards currently retail for less than \$200, and may be worth many times that in terms of operator comfort.

Spreadsheet users who frequently enter data into large templates may also benefit from one of the new keyboards with built-in pointing devices, which give mouse-like capabilities without taking your hands off the keys. (I particularly dislike the *mus computeralis* (the common digital mouse) for keyboard work. Meecees (pl. mouse) were built for three-handed PC users, of whom I know none!) Units with built-in trackballs, joysticks and pointer-pads (like the well-known Koala pad) are commercially available in the \$250-400 range.

Anyone who enters the same, or similar, material repeatedly should be using a software keyboard enhancer, such as Pro-Key, SuperKey, or SmartKey. These programs assign multiple characters to a single keystroke, and can permit *fill in the blank* substitutions in an assignment. A keyboard enhancer does take up some memory, but relatively little. Also, incompatibilities with other programs are rare except for a few word-processing packages which take full control of the keyboard away from DOS. (Fortunately, none of the best-selling word processor programs do this.) Keyboard enhancers are inexpensive (under \$125), and oh-so effective.

HELP FOR THE SOFTWARE-BOUND USER

Being *hung up* by software performance is the mirror-image of being CPU-bound. Indeed, if you are wedded to a program which is known to be a *dog* in terms of slow execution, one of the CPU upgrades noted above will likely improve the situation. This is not as uncommon a problem as one might think. Cut-throat competition in *horizontal* software (e.g. word-processing, database, spreadsheet, programs useful for almost anyone in business) has imposed high standards for program-execution speed. However, many *vertical market* (e.g. for specific businesses) packages are still very inefficient. An application poorly coded in interpreted BASIC can make even an AT-class PC look sluggish. Often, the program with the *best* features for a specific situation is also the worst performer. As competition rises in the *vertical* market, program execution speed will improve, but this is cold comfort for today's user. If you are in such a vertical-package bind, best grit your teeth and upgrade your CPU.

One possible and easily addressed cause of poor software performance is repeated disk accesses for program overlays (parts of the program which have to be called from disk to memory to perform various functions). Expanding memory and using ramdisk to hold the overlay files can end this problem inexpensively. This method also works wonders for programs whose overlays are so big that they all

Desktop Publishers, Int'l.

won't fit on a single diskette (noteable examples being DisplayWrite 2 and 3). Using a hard disk also works well, but imposes other costs (see above).

If your favorite spreadsheet or word-processor causes you to age visibly between recalculations or block moves, you should at least look at the market for alternative software. Bitter competition has caused prices to plummet, and performance/price ratios to skyrocket, even more so than for printers! You may also find that there is a new version of your favorite program, with upgrades available for a pittance, and much better performance. A classic example is the dramatic difference between Microsoft Word versions 1.0 and 2.0. The former was a veritable mutt; the latter, an industry leader. If you wish to switch manufacturers, it is likely that your existing data files will be at least partially transferable to the new program, though be sure to check this out thoroughly before buying! Also, be sure to include the expense of re-learning/re-training on the new software in your cost/benefit analysis.

If you are uncertain where your favorite package finishes in the performance sweepstakes, get a hold of an index to Software Digest and see if your program has figured in one of their excellent competitive reviews. The issue you need will likely be sitting somewhere in Corporate Computer Headquarters, or in the basement of someone like myself (yes, I subscribe). The review may not tell you if someone else's program will work better for your particular applications, but will let you know if your current package is really much slower than the competition.

The BOTTOM LINE

Though there are many ways to add power to a PC, in order to upgrade effectively, it is desirable to use the following strategy.

1. Identify what part(s) of your computer need improvement.
2. Determine if an enhancement is cost-effective.
3. Pick a solution in light of your available resources, budgetary and technical, and the potential costs and benefits of the proposed upgrade.

In my experience, individuals who take such a systematic approach are almost invariably successful in improving PC performance and the quality of their lives as PC users. 

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Creating A Copy Protected Program

by Edwin Thall

Generate a diskette file That cannot be duplicated By MS/PC-DOS

You've probably noticed that copy protected programs work properly when executed from the original diskette, but fail when you attempt to run a copied version. Popular methods for preparing protected diskettes include unorthodox formatting, physical marking of the surface, and altering rotation speed. In this article, I describe key parameters for generating a diskette sector which cannot be copied by PC-DOS. I also demonstrate the step-by-step formation of a copy protected program. All examples and displays cited in this paper pertain to the DOS 3.00 360K format.

The read only memory (ROM) built into IBM PC's and compatibles store the routines needed to operate the various peripherals, such as the diskette drives. These routines are referred to as the Basic Input/Output System (BIOS). The ROM-BIOS is a permanent part of the computer hardware and cannot be altered.

MS/PC-DOS is manufactured by Microsoft, Inc. and is not part of the hardware. DOS provides numerous services such as creating new files, deleting old files, copying files, etc. Most of us rely on DOS to carry out these tedious chores and seldom, if ever, access the BIOS directly. Our programs call a DOS routine which in turn, calls a ROM-BIOS routine. However, DOS was created by mortals and has limitations. The changing of a key parameter can render MS/PC-DOS unserviceable.

DISKETTE PARAMETER TABLE

Software interrupt instructions enable programs to access ROM-BIOS routines. The ROM addresses of these routines are stored in the computer's first 1024 memory locations. This part of memory, known as the interrupt vector table, is loaded from the system diskette during the start-up. You may display the first 128 bytes of this table with the Debug utility. From DOS, type:

A)DEBUG

-D 0:0

```
0000:0000 5A 50 1F 01 ED 01 70 00-C3 E2 00 F0 ED 01 70 00
0000:0010 ED 01 70 00 54 FF 00 F0-47 FF 00 F0 47 FF 00 F0
0000:0020 A5 FE 00 F0 87 E9 00 F0-DD E6 00 F0 DD E6 00 F0
0000:0030 DD E6 00 F0 DD E6 00 F0-57 EF 00 F0 ED 01 70 00
0000:0040 65 F0 00 F0 4D F8 00 F0-41 F8 00 F0 54 09 70 00
0000:0050 39 E7 00 F0 59 F8 00 F0-2E E8 00 F0 D2 EF 00 F0
0000:0060 00 00 00 F6 75 0A 70 00-6E FE 00 F0 E7 01 70 00
0000:0070 53 FF 00 F0 A4 F0 00 F0-22 05 00 00 00 00 00 F0
```

Each interrupt is assigned four bytes pointing to the address of its routine. The four bytes are given in reverse order. For example, the first interrupt points to address 011F:505AH (H = hexadec-

imal system). Interrupt 30 (INT 1EH) does not point to a ROM-BIOS routine, but to a table of eleven consecutive bytes. This table, known as the diskette parameter table (DPT), defines how information is arranged on the diskette and regulates the operation of the diskette drives. The original DPT is stored in the ROM at address F000:EFC7H. You can look at this table with:

```
-D F000:EFC7,EF0D
F000:EFC7 CF 02 25 02 08 2A FF 50 F6 19 04
```

Starting with DOS 1.10, IBM modified this table to improve the performance of the diskette drives and the ROM table was replaced with one in the random access memory. The interrupt vector table reveals that INT 1EH (offsets 0078H-007BH) begins at address 0000:0522H. You can display the modified DPT with:

```
-D 0:522,52C
0000:0522 DF 02 25 02 09 2A-FF 50 F6 0F 02
```

A description of the eleven diskette parameters is provided in Table 1. Offsets 522H, 523H, 524H, 52BH, and 52CH are required for the operation of the diskette drives and should not be changed. The other parameters define the diskette format and can be modified. The default values for these parameters are:

512	bytes per sector
9	sectors per track
42	bytes between sectors
80	bytes between ID and data fields
246	format data fill

The format data fill parameter specifies the binary pattern written to the data field. The decimal value (246) corresponds to F6H and 512 bytes of 11110110 are initially stored in formatted sectors.

THE CHRN

The 5 1/4" floppy is organized into 40 concentric tracks per side. The 360K format divides each track into 9 sectors. There are two major components to a sector: the identification (ID) field and the data field. Data is stored in the data field and is of course, the most important part of the sector. The ID field stores the information needed to locate sectors. The diskette organization by track and sector is illustrated in Figure 1.

Before a diskette may be used, each track must be individually formatted. A vital part of a sector's ID field, the CHRN, is written during this operation. The CHRN is a four-byte field representing the following:

C	Track number	(00-27H)
H	Head number	(00 = side 0, 01 = side 1)
R	Sector number	(01-09)
N	Sector length	(00 = 128, 01 = 256, 02 = 512, 03 = 1024)

For example, the CHRN for the sixth sector on track 09, head 00, and holding 512 bytes of data is 09000602. The standard sector length is 512 bytes (N = 02). While DOS can only locate sectors of this size, the BIOS can handle all allowed sector lengths. For protected diskettes, various combinations of the CHRN may be used.

DISKETTE INPUT/OUTPUT OPERATIONS

You can read, write, and format sectors at the BIOS level by means of interrupt 19 (INT 13H). The registers required for INT 13H operations are described in Table 2.

Table 1
Description of Diskette Parameters

Offset	Parameter	Function
522H	step rate time	controls rate head moves from track to track
523H	head load time	wait time before read/write
524H	motor wait time	delay until motor off
525H	bytes per sector	(00 = 128, 01 = 256, 02 = 512, 03 = 1024)
526H	end of track	number of sectors per track
527H	gap length	bytes separating sectors
528H	data length	used when sector length not specified
529H	gap length for format	bytes separating ID and data fields
52AH	fill byte for format	value stored in data field after format
52BH	head settle time	wait settle time before read/write
52CH	motor start time	delay until motor off

When a BIOS INT 13H operation fails, the diskette controller is disabled and must be reset for the next operation. The two instructions for reset are:

```
MOV AH,00
INT 13H
```

DOS detects and handles all hardware-related disk errors, but BIOS expects you to perform this job. The status of a BIOS INT 13H operation is returned to the carry flag (success or failure) and the AH register (cause of error). The carry flag is set to zero (NC) for a successful operation. The error codes returned to the AH register are listed in Table 3. You may encounter a read operation giving an error even though there is nothing wrong. This condition arises because the disk drive motor takes about a half second to reach full speed, and BIOS does not wait between starting the motor and issuing the read command to the disk interface. Therefore, the hardware may try to read from the disk before it is rotating at the proper speed. The IBM Technical Reference Manual suggests that "three retries are required on reads to ensure the problem is not due to motor start-up."

IRREGULAR SECTOR 08000101

Normal diskette sectors are 512 bytes in length and numbered in sequence. The CHRN's for the nine sectors located on track 08/head 00 are:

```
08000102
08000202
08000302
08000402
08000502
08000602
08000702
08000802
08000902
```

Irregular sectors deviate from this pattern and there are various ways to represent them. One approach is to number the sectors out of sequence (08000102, 08000702, 08000502, 08000202, etc.). Another method is to repeat CHRN combinations (08000102, 08000202, 08000202, 08000202, 08000502, 08000602, etc.).

Table 2
Registers Required for INT 13H Operations

Register	Function	Parameters
AH	Diskette Operation	(00-05*)
AL	Number of sectors	(01-09)
CH	Track number	(00-27H)
CL	Sector number	(01-09)
DH	Head number	(00=side 0, 01=side 1)
DL	Drive number	(00=drive A, 01=drive B)
ES:BX	Address of buffer	(ES=segment, BX=offset)

- * 00 Reset disk system
- 01 Read status of system
- 02 Read sectors into memory
- 03 Write sectors to diskette
- 04 Verify sectors
- 05 Format track

Table 3
BIOS INT 13H Error Codes

00	no error
01	bad command
02	address not found
03	diskette write protected
04	sector not found
08	direct memory access error
10	CRC error
20	disk controller error
40	seek error
80	attachment failed to respond

Irregular sectors confuse DOS and the operating system has difficulty locating them.

Another technique for generating irregular sectors is to change the N (of CHRN) to 00, 01, or 03. Whereas DOS always uses N=02 as the sector length, the BIOS assumes the value stored in the diskette parameter table.

The development of my copy protection scheme begins with the formation of an irregular sector. I suggest that you follow with an experimental diskette (360K format) containing only the operating system and Debug.

I have arbitrarily decided to create irregular sector 08000101. The first sector on track 08/head 00 will be assigned a data length of 256 bytes (N=01). The assembly language program to format this irregular sector, along with eight regular sectors, is provided in Figure 2.

I begin the Format program by resetting the diskette controller. Next, the registers are loaded to specify the operation, track, head, and drive. The BX register points to the series of the nine CHRN entries. There must be one entry for every sector formatted. Note the CHRN for the first sector on track 08 (08000101). The N parameter designates it an irregular sector. Use the assemble command (A 100H) to enter this program (do not include comments). After you type A 100H, the system will display DS:0100H and wait for you to enter the first instruction (MOV AH,00). When you are finished entering the Format program, hit <ENTER> twice to exit the assemble mode.

The Format program is stored in memory and is ready for execution. Before running the program, change the fill byte parameter from F6H to AAH. The contents of the irregular sector will be easily recognized by a long string of AA's. To alter the fill parameter, type:

```
-E 0:52A
0000:052A F6:AA
```

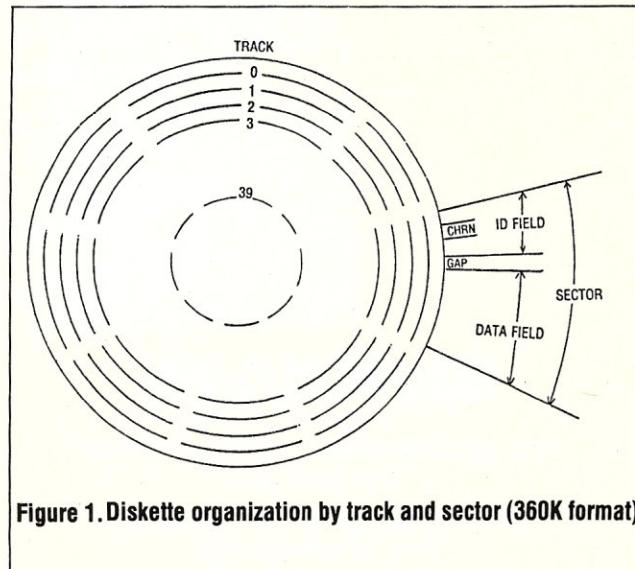


Figure 1. Diskette organization by track and sector (360K format)

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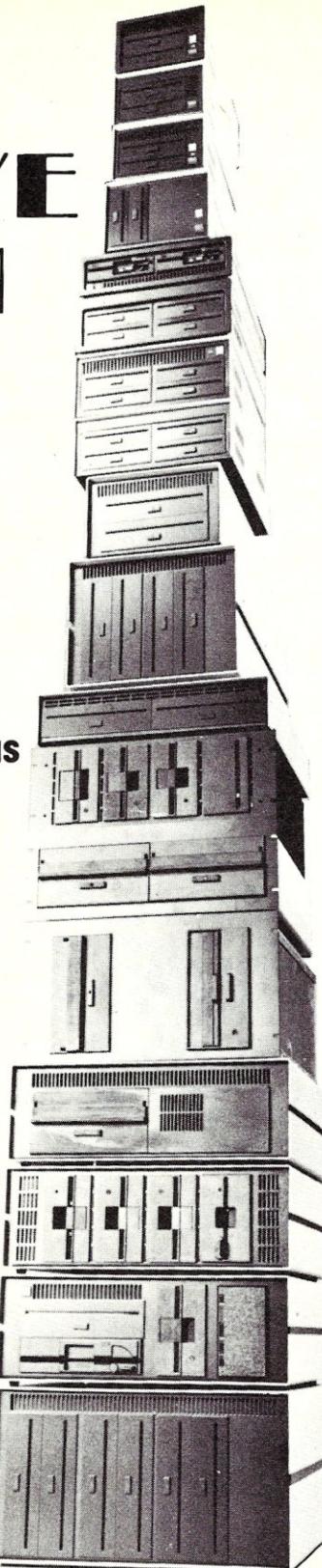
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```

DS:0100  MOV  AH,00      ;RESET DISK CONTROLLER
DS:0102  INT  13      ;BIOS DISK I/O
DS:0104  MOV  AH,05      ;FORMAT TRACK
DS:0106  MOV  AL,09      ;9 SECTORS
DS:0108  MOV  CH,08      ;STARTING AT TRACK 08
DS:010A  MOV  CL,01      ;"      SECTOR 01
DS:010C  MOV  DH,00      ;"      HEAD 00
DS:010E  MOV  DL,00      ;"      DRIVE A
DS:0110  MOV  BX,0117      ;POINT TO CHRN
DS:0113  INT  13      ;BIOS DISK I/O
DS:0115  INT  20      ;RETURN TO DOS
DS:0117  DB   08 00 01 01
DS:0118  DB   08 00 02 02
DS:011F  DB   08 00 03 02
DS:0123  DB   08 00 04 02
DS:0127  DB   08 00 05 02
DS:012B  DB   08 00 06 02
DS:012F  DB   08 00 07 02
DS:0133  DB   08 00 08 02
DS:0137  DB   08 00 09 02

```

Figure 2. Format program (creates sector 08000101)

Execute the Format program with the diskette in drive A.

-G

Sector 08000101 cannot be read by DOS. This sector is logical sector number 90H and if you attempt to read with the conventional Debug "L" command, the following error is returned:

-L 400 0 90 1
Disk error reading drive A

You must invoke a BIOS INT 13H operation to read sector 08000101. Change the Format program to a Read program with:

```

-E 105
DS:0105  05.02
-E 107
DS:0107  09.01
-E 111
DS:0111  17.00 01.08

```

The Read program stores the contents of sector 08000101 into a buffer area beginning at offset 0800H. You may display the Read program with the unassemble command (U 100H). In my display (Figure 3), I have included comments next to the three modified instructions.

Since irregular sector 08000101 was assigned 01 for its N parameter, the sector length parameter in the DPT must be set at this value before you attempt to run the Read program.

```

-E 0:525
0000:0525 02.01

```

If you wish to check the status of this read operation, you must do it prior to the program's return to DOS. You may run the program using G 115H in order to stop execution before control is returned to DOS (INT 20H). When offset 115H is reached, the program stops and the registers/flags are displayed.

```

-G 115
AX=1000 BX=0800 CX=0801 DX=0000 SP=FFFE BP=0000 SI=0000 DI=0000
DS=???? ES=???? SS=???? CS=???? IP=0115 NV UP EI NG NZ AC PE CY
DS:0115 CD20      INT 20

```

The error (AH=10) indicates that the read operation failed because of a cyclic redundancy check (CRC). This type of error occurs when the number of bytes written to a sector does not agree with the number read. The sector length parameter in the diskette

```

DS:0100  B400      MOV  AH,00
DS:0102  CD13      INT  13
DS:0104  B402      MOV  AH,02      ;READ OPERATION
DS:0106  B001      MOV  AL,01      ;ONE SECTOR
DS:0108  B508      MOV  CH,08
DS:010A  B101      MOV  CL,01
DS:010C  B600      MOV  DH,00
DS:010E  B200      MOV  DL,00
DS:0110  BB0008      MOV  BX,0800      ;BUFFER AREA
DS:0113  CD13      INT  13
DS:0115  CD20      INT  20

```

Figure 3. Read program (reads sector 08000101)

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```
DS:0100 B400    MOV    AH,00
DS:0102 CD13    INT    13
DS:0104 B402    MOV    AH,03    ;WRITE OPERATION
DS:0106 B001    MOV    AL,01
DS:0108 B508    MOV    CH,08
DS:010A B101    MOV    CL,01
DS:010C B600    MOV    DH,00
DS:010E B200    MOV    DL,00
DS:0110 BB0008  MOV    BX,0800    ;BUFFER AREA
DS:0113 CD13    INT    13
DS:0115 CD20    INT    20
DS:0800 MOV    DX,0809    ;MESSAGE OFFSET
DS:0803 MOV    AH,09    ;PRINT STRING
DS:0805 INT    21    ;CALL DOS
DS:0807 INT    20    ;RETURN TO DOS
DS:0809 DB     "THE IRREGULAR SECTOR WAS READ $"
```

Figure 4. Write program (writes 256 bytes to sector 08000101)

parameter table specified 512 bytes to be written during the format of the irregular sector but the read operation requested 256 bytes. You can display the contents of the buffer area with:

-D 800,FF

You should be looking at 256 consecutive bytes of AAH. The irregular sector was read and an error was returned to indicate a discrepancy between the number of bytes read (256) versus the number written (512).

WRITING TO THE IRREGULAR SECTOR

For our copy protection scheme, a short program is written to the irregular sector. Convert the Read program (AH=02) to a Write program (AH=03) with:

-E 105
DS:0105 02.03

The routine to print "THE IRREGULAR SECTOR WAS READ" will be stored in sector 08000101. Enter the program in Figure 4 beginning with offset 0800H.

-A 800 DS:0800
MOV DX,0809

The 256 bytes (offsets 0800H-08FFH) are written to sector 08000101 when you run the program. Remember to reset the instruction pointer register (IP=0115H) to 100H before executing.

-RIP
IP 0115
:100
-G

Now attempt to read sector 08000101. You should be able to do so without the dreaded CRC error. Convert the current program in memory from a write (AH=03) to a read (AH=02) and then run.

```
-E 105
DS:0105 03.02
-G 115
AX=0000 BX=0800 CX=0801 DX=0000 SP=FFFE BP=0000 SI=0000 DI=0000
DS=???? ES=???? SS=???? CS=???? IP=0115 NV UP EI NG NZ AC PE NC
DS:0115 CD20    INT    20
```

The AH register (00) indicates that the read operation worked. Run the program again if an error was returned in the AH register. Restore the sector length parameter to the standard value (N=02). If you should quit Debug without making this adjustment, you will have to reset the computer to access any files on the diskette!

-E 0:525
0000:0525 01.02

MODIFY FAT

Irregular sectors may cause hardware errors and DOS must be notified when one exists. The FAT (file allocation table) stores sector access information. It is essential to modify the FAT for our copy protection scheme. The irregular sector is logical sector

```

DS:0000 FD FF FF 03 40 00 05 60-00 07 80 00 09 A0 00 FF
DS:0010 CF 00 0D E0 00 0F 00 01-11 20 01 13 40 01 15 60
DS:0020 01 17 80 01 19 A0 01 1B-C0 01 1D E0 01 1F 00 02
DS:0030 21 20 02 23 40 02 25 60-02 FF 8F 02 29 A0 02 2B
DS:0040 C0 02 2D E0 02 2F 00 03-31 20 03 33 40 03 35 60
DS:0050 03 37 80 03 39 A0 03 3B-C0 03 FF 0F 00 00 00 00 00
DS:0060 00 00 00 00 00 00 F7 0F-00 00 00 00 00 00 00 00 00
DS:0070 00 00 00 00 00 00 00 00-00 00 00 00 00 00 00 00 00

```

Figure 5. The first 128 bytes of the modified FAT

number 90H or 144. The cluster number in the FAT may be determined from the logical sector number (LSN) by:

$$\text{Cluster number} = .5(\text{LSN} - 12) + 2 = .5(144 - 12) + 2 = 68$$

LSN 144 corresponds to cluster 68 in the FAT. A cluster entry of FF7H is the code to inform DOS that sectors of the cluster are bad and should not be allocated. Offsets 0066H and 0067H in the FAT point to cluster 68. To modify the FAT, place the diskette in drive A and type:

```

-L 0011
-E 66
DS:0066 00.F7 00.0F
-W 0011
-L 0011
-D 0

```

The modified FAT (Figure 5) now contains F7H and 0FH at offsets 0066H and 0067H, respectively.

THE COPY PROTECTED PROGRAM

The name of the copy protected program is CPROTECT.COM. The function of this program is to execute the routine written to sector 08000101. CPROTECT.COM was

```

CSEG SEGMENT
ASSUME CS:CSEG
;SET DISKETTE PARAMETER TO 256 BYTES PER SECTOR
PUSH DS ;SAVE ORIGINAL DS
MOV AX,0 ;DS FOR DISKETTE PARAMETER
MOV DS,AX ;SET DS=0
MOV BX,525H ;SECTOR SIZE OFFSET
MOV AL,1 ;256 SECTOR SIZE CODE
MOV [BX],AL ;SET SECTOR SIZE TO 256
POP DS ;RESTORE ORIGINAL DS
;BIOS ROUTINE TO READ SECTOR 08000101
MOV CX,3 ;TRY 3 READS
AGAIN: PUSH CX ;SAVE COUNT
MOV AH,0 ;DISK RESET
INT 13H ;BIOS DISK I/O
MOV AH,2 ;READ DISK
MOV AL,1 ;READ ONE SECTOR
MOV CH,8 ;FROM TRACK 8
MOV CL,1 ;" SECTOR 1
MOV DH,0 ;" HEAD 0
MOV DL,0 ;" DRIVE A
MOV BX,800H ;BUFFER AREA
INT 13H ;BIOS DISK I/O
;ATTEMPT 3 TIMES IF READ FAILS
CMP AH,0 ;DID READ FAIL ?
JZ PASSED ;NO--READ PASSED
POP CX ;YES--POP READ COUNT
LOOP AGAIN ;TRY READ AGAIN
MOV CL,0FFH ;SET FAIL
;SET DISKETTE PARAMETER TO 512 BYTES PER SECTOR
PASSED: PUSH DS ;SAVE ORIGINAL DS
MOV AX,0 ;DS FOR DISKETTE PARAMETER
MOV DS,AX ;SET DS = 0
MOV BX,525H ;SECTOR SIZE OFFSET
MOV AL,2 ;512 SECTOR SIZE CODE
MOV [BX],AL ;SET SECTOR SIZE TO 512
POP DS ;RESTORE ORIGINAL DS
;WAS THE IRREGULAR SECTOR READ ?
CMP CL,0FFH ;DID READ FAIL ?
JZ PRINTM ;YES--PRINT FAILED MESSAGE
MOV AX,800H ;NO--PRINT SUCCESS MESSAGE
JMP AX ;AT OFFSET 0800H
;PRINT FAILED MESSAGE
PRINTM: MOV DX,OFFSET MESS
MOV AH,9 ;PRINT STRING
INT 21H ;CALL DOS
INT 20H ;RETURN TO DOS
;STORE FAILED MESSAGE
MESS DB 0DH,0AH,'PROGRAM FAILED $'
SEG ENDS
END

```

Figure 6. Assembler code (CPROTECT.ASM)

assembled from the source code (CPROTECT.ASM) listed in Figure 6.

CPROTECT.COM changes the sector length parameter from 512 to 256 bytes. Next, the BIOS read routine stores the contents of sector 08000101 in a buffer area (offset 0800H). The AH register is compared to 00 to determine whether the read operation was successful. If three read operations fail, the CX register is set to FFH. The sector length parameter is restored to 512 bytes before control is returned to DOS. The message "PROGRAM FAILED" is displayed when three read operations fail (CX = FFH). Otherwise, the routine stored in sector 08000101 is executed and the message "THE IRREGULAR SECTOR WAS READ" is displayed.

I wrote CPROTECT.ASM and compiled it with the IBM Macro Assembler to form CPROTECT.OBJ. The object file was linked and converted to CPROTECT.COM.

SUMMARY

The copy protected program is complete. You can run CPROTECT.COM from DOS with:

A) CPROTECT

The program will display the message "THE IRREGULAR SECTOR WAS READ" when executed from the original diskette in drive A. You may copy CPROTECT.COM to a second diskette, but the program is destined to fail because the irregular sector was not copied. If you attempt to copy the entire diskette with the DIS-KCOPY command, the following messages are displayed:

Unrecoverable read error on source
Track 08, side 0
Target diskette may be unusable

Dr. Edwin Thall is Associate Professor of Chemistry at The Wayne General and Technical College of The University of Akron. He teaches chemistry and computer programming.



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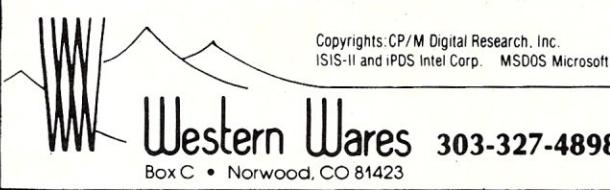
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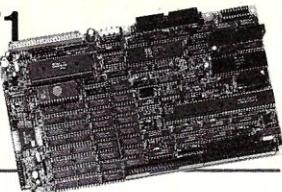
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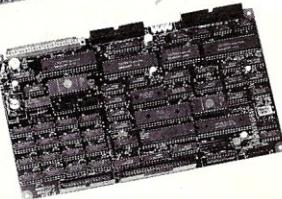
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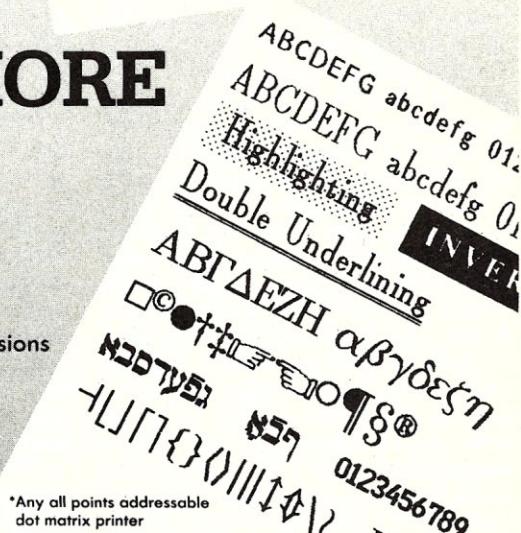
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Build A Smart Keyboard Interface

by John Monahan

Ever wished your keyboard had more keys or all your programs used the same control codes for cursor movements and editing functions?

This has always been my problem! Recently I decided to do something about it. After all, if I have my own personal computer, I should be able to have it do the things I want to do. I happen to have an S-100 system with Z80 and 8086 CPU's, and since I use an IBM-PC compatible keyboard and run MS-DOS, I wanted to run MS-DOS software that looks for an IBM keyboard.

My approach, which can be added to many other types of systems, is to have the keyboard talk to a keyboard controller which in turn talks to the computer. By having intelligence between a dumb keyboard and the computer, a truly powerful system can be set up, because the controller does not take up CPU space; it is always present, even on power up, works with different operating systems, and, as we shall see, can be much more powerful than its software counterpart.

THE CIRCUIT

To have any kind of flexibility, one must put together a unit containing an 8-bit microprocessor, a few I/O ports, as well as RAM and ROM memory. There are a number of very good single-chip, 8-bit microprocessors that have these features. The Intel 8048 is a classic example. However, in order to put something together quickly in hardware and to program it with an assembler I already had, I used the popular Z80. It requires few parts to assemble a very powerful system. A Z80 CPU with a 2716 ROM, 2Kx8 RAM, and two Zilog PIO's, together with a few small "glue" chips are all we need to construct a computer with 4 parallel ports with handshaking. Figure 1 shows the complete computer.

Because Z80 output pins are TTL compatible and capable of driving one TTL load, no buffers are required on the address, data or control lines. The 11 lines needed to address the 2716 ROM and 2Kx8 RAM chips can be connected directly to the Z80. These correspond to address lines A0 to A10. Address line A11 selects the

Add Intelligence To Your Keyboard Input

memory in the ROM ($A_{11} = 0$) or RAM ($A_{11} = 1$). Pin 20 is the critical pin for selecting the 2716 ROM. Whenever this (CS^*) pin is low, the ROM places data on output pins: 9, 10, 11, 13, 14, 15, 16, and 17. These are then read by the data-bus pins of the Z80 when the Z80 brings $MEMR^*$, RD^* , and A_{11} low. Any write-to-RAM-memory or R/W-to-an-I/O port will not cause the 2716 CS^* to go low and so will not cause it to place data on the data bus.

The operation of the 2K RAM chip is a bit more complicated. We have two possibilities. First a read from the memory; Pin 21 (WE^*) should be high. No problem here since it is connected to the Z80 WR^* line. Pin 20 (OE^*) of the RAM chip is connected to the Z80 RD^* line. When this is low, along with the Z80 $MREQ^*$ and a high Z80 A_{11} line, the 2K RAM places the selected data (determined by address lines $A_0 - A_{10}$) on the data bus to be read by the Z80. For a write to RAM, memory-pin 20 (OE^*) of the RAM must be held high. Pin 21 (WE^*) is brought low by the Z80 WR^* line. The CE^* is selected as described above for the read cycle.

Because we are using only 8, of the possible 256 I/O ports available on the Z80, we do not have to decode the address lines completely to address the two Zilog PIO's. The PIO's are Zilog's answer to the Intel 8255. They are 40-pin LSI chips that contain 2 separate 8-bit parallel ports with handshaking. They may be programmed in a number of configurations. More on this later.

The PIO's have a unique built-in capability to interrupt the Z80 in an ordered manner. We will not be using this characteristic of the PIO, however this

requires that the Z80 clock and M1 pins to be directly connected (see Figure 1).

Each PIO is selected by bringing pin 4 (CS^*) low. We do this on PIO1 and PIO2 by lowering address lines A_2 and A_3 , respectively. Because each PIO contains 4 ports, we use address lines A_0 and A_1 to select these. Pin 5 of the PIO selects the command or data port. Pin 6 selects either port A or B on the chip. Address lines A_0 to A_3 will always be changing as the CPU reads memory, however, only when the $IORD^*$ line goes low, will the PIO be addressed. This only happens when the Z80 code forces the CPU to read or write to a port.

The Z80 requires an external clock signal. Anything from 2 to 4Mhz is fine for this application. This is provided by the simple oscillator circuit connected to pin 6 of the Z80. Note that a 600Ω pullup resistor is required, since Zilog specifies the voltage swing must be within 0 to 5 volts.

CHECK OUT

So far we have assembled the bare essentials of a computer. With the appropriate software in ROM, the Z80, after power up, can be made to look at one data port and transfer the data across to another port. Complicated character translations can be done by adding on software as described below. If this is the first time you have put together a system of this complexity, you may first want to try something simpler first: namely fill a 2716 ROM with 76h's (the Z80 HALT instruction), switch on the power, and check that pin 18 of the Z80 has gone low, indicating the CPU has gone into the halt state. If this does not happen, more than likely you have one of your address or data lines connected incorrectly.

INTERFACING TO THE KEYBOARD

Connecting the Z80 board to an IBM-like keyboard entails one complication. The keyboard sends the data serially over two wires. One contains the data as 8-bits, the second, the keyboard clock data associated with the data. It would have been nice if IBM had chosen to use a standard UART-compatible, serial-data

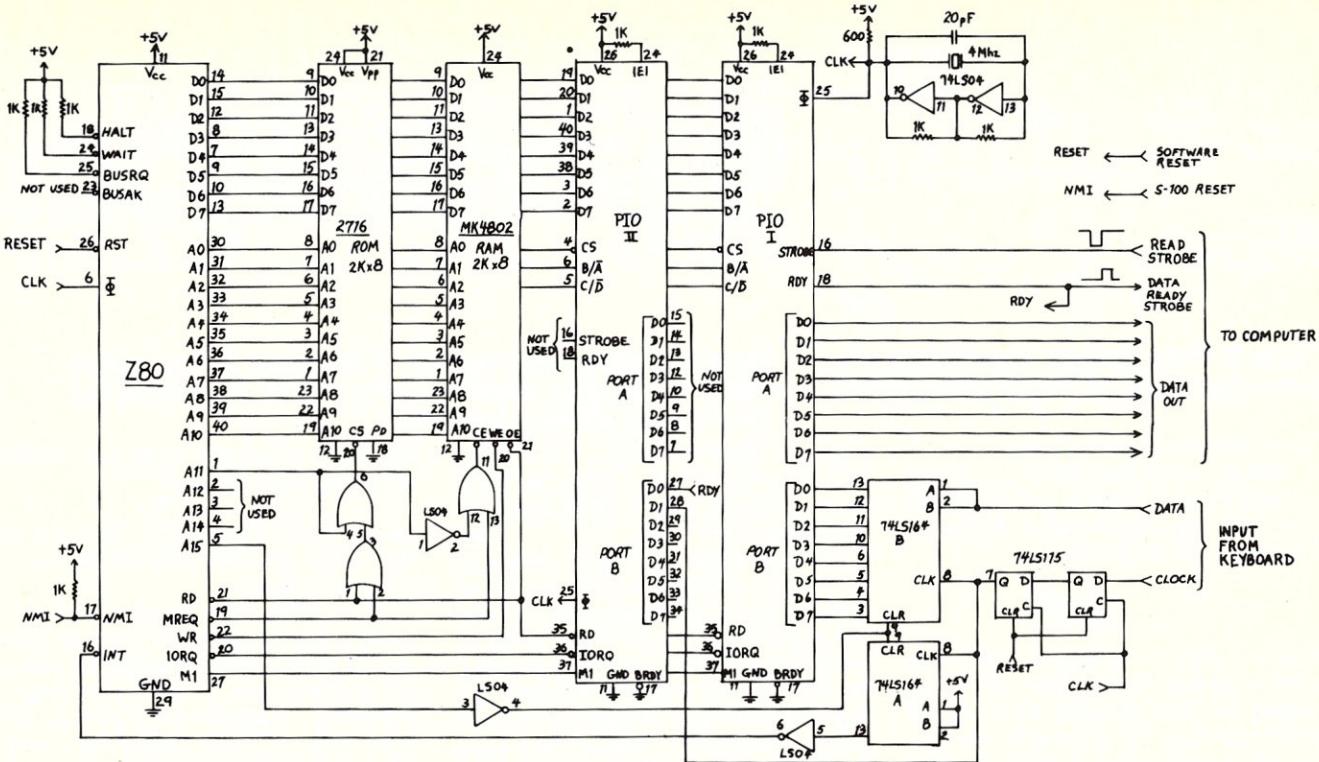


Figure 1. Keyboard controller circuitry

format. No such luck. The data is sent as 8-bits with no start bits or stop bits (Figure 2).

While it would be possible to program the Z80 to monitor one bit of an I/O port to assemble a byte from the serial data, the hardware solution of using two 8-bit shift registers makes life so simple that I opted for the easy way out. Here is how it works. Eight serial clock bits are shifted into the LS164-A-register (Figure 1) from the raw clock line coming from the keyboard. At the same time, 8 data bits are shifted into position in the LS164-B-register. Pins 3, 4, 5, 6, 10, 11, 12, and 13 of this chip will end up with the data in parallel form. The rising edge of the final clock bit raises pin 13 of the LS164-A-register. This, via the LS04 inverter, causes the INT* input to the Z80 to go low. This in turn causes the Z80 to call on an interrupt in ROM, which will pulse address line A15 high, clearing the two LS164 shift registers and readying them for the next byte from the keyboard. The raising of A15 is a cheap way of getting a fast 1-bit output port. Since our computer has no memory above 4K, we do not have to worry about the value of the high-order address lines. Writing a byte to address F000h in RAM will raise and lower A15 with no damage to RAM contents in low memory. The LS175 dual flip-flops (IC A) aligns the clock information with the data from the keyboard.

We are almost there, hardware-wise! All that remains to be done is to have the Z80 process the data and pass it on to the main computer. On my system, the key-

board input is from a SD Systems 8024 Video board. This board requires a keyboard with a parallel port. The data must be strobed into this port by a positive-going pulse. I have modified this board slightly so that once data is read from this port, a negative-going pulse is sent back to the smart keyboard interface letting it know the data has been read. Other boards may have different strobe protocols. These can often simply be accommodated by one or two 74LS04 inverters in the circuit. For those computer systems that have a serial keyboard, you could replace one of the PIO's with a Zilog SIO. This is a simple hardware replacement, but you should carefully study the software setup procedure to talk to the SIO.

Pin 26 of the Z80 (reset) is connected to the main-computer reset line. In this way, a reset to the main computer also resets the smart keyboard circuit. Any keyboard characters in a queue or taken through a translation table are flushed out in this process. The NMI* pin of the Z80 is connected to a one-bit output port of the main computer. The function of this will become clear when we discuss the software used to drive this board. Other pins of the Z80 are left either unconnected or tied high via a 1K resistor.

SOFTWARE

Writing software for a computer like this is a lot of fun. Because you have complete control of the smart-keyboard interface Z80 at all times, you can place values in certain registers and know they are always going to be there. We can, for ex-

ample, really make use of the Z80 alternate registers. The software I used to program this board has been submitted to the public-domain SIG/M users group and will be available in one of their future releases. What I would like to do, is step you through the main points. The complete details for all routines can be found in the public-domain code itself. The first two lines of code start off:

ORG 00H
LD SP, STACK

Since the Z80 reads an opcode from memory location 0, at power on or a reset, the ROM code must originate here. First we need a valid location for the stack. To be on the safe side, we will put the stack high up in RAM, but just below certain reserved RAM memory locations. I have used **STACK = OFF0h**.

Next we initialize the Zilog PIO's. The 2 PIO's have 4 ports which can be configured in software as input, output, or bidirectional. Consult the Zilog technical literature for a detailed explanation of what this entails. We will set up both PIO port A's as output ports (MODE 0) and port B's as input ports (MODE1).

The PIO's also have the capability of generating an interrupt under certain data-transfer conditions. We do not need this here and so we must program the chips to disable this function.

Programming the chip is easy. You select the appropriate PIO control port (data port + 1 in this example) and send two bytes of code. Since we have 4 ports in all, we must send 2 bytes to each of 4 ports.

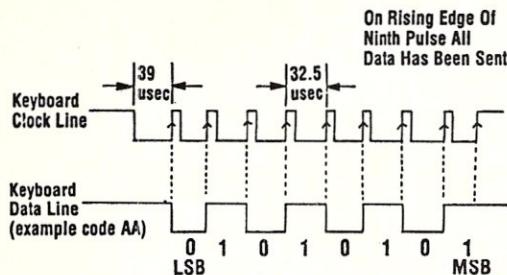


Figure 2. Timing diagram of serial data sent from a Keytronics IBM-compatible keyboard.

This is done as shown in Listing 1.

Having set-up the PIO's, it is a good practice to clear them of any false data they may have acquired before or during initialization. We do this by:

```
IN      a, (DATA$B)
IN      a, (DATA$C)
```

Next we have to enable the Z80 in the correct interrupt mode. Again you should consult the Zilog literature if you do not understand how this is done. In our case we need interrupt mode 1. This will cause the CPU to jump to location 38H in our ROM anytime the INT* (pin 16) on the Z80 is pulled low. At that location will be the code that will get data from the PIO port and process it. An INT will occur only when the hardware has received 8 serial bits of data from the keyboard (the low at pins 1 & 2 of the 74LS174-B have been shifted 8 times). The code at 38H is shown in Listing 2.

What we are doing here, is quickly taking the data byte at the keyboard and placing it in a cyclic 256-byte buffer in RAM memory. We do not know when such an INT would occur and so cannot count on what is in the "main" Z80 registers. For this purpose, we set aside the alternative Z80 registers. As described below, the keyboard data port will ALWAYS be in register C' and HL' will ALWAYS point to the end of the incoming character queue. One nice thing about the INC L, is that it insures the queue will always wrap around after 256 bytes. We do not have to move pointers back to the beginning of the queue once they reach its end. We have already discussed the use of address line A15 to reset the 74LS164's. We waste the IY reg to do just this in this application. It is setup with the value F000h. As you can see from the timing diagram of the clock and data lines in Figure 2, there is one extra clock pulse we have to absorb, before the keyboard is finished sending its byte of data. This is monitored at bit 1 of the PIO 2, port-B bit 1 (Figure 3).

At org 100H in the ROM, we have the code (Listing 3) to set-up the computer and keep it happy while it is waiting for a character.

What we have done in the above code is

3B	3C	01	02	03	04	05	06	07	08	09	0A	0B	0C	0D	0E	45	46
BB	BC	81	82	83	84	85	86	87	88	89	8A	8B	8C	8D	8E	C5	C6
3D	3E	0F	10	11	12	13	14	15	16	17	18	19	1A	1B	29	47	48
BD	BE	8F	91	92	93	94	95	96	97	98	99	9A	9B	9C	C7	C8	49
3F	40	1D	1E	1F	20	21	22	23	24	25	26	27	28	1C	4B	4C	4D
BF	C0	90	9E	9F	A0	A1	A2	A3	A4	A5	A6	A7	A8	9C	CB	CC	4E
41	42	2B	2A	2C	2D	2E	2F	30	31	32	33	34	35	36	37	4F	50
C1	C2	AB	AA	AC	AD	AE	AF	B0	B1	B2	B3	B4	B5	B6	B7	D0	51
43	44														3A	52	53
C3	C4														BA	D2	D3

Figure 3. Keyboard code chart for a Keytronics IBM-compatible keyboard. The upper number on each key is for downstrokes and lower number is for key upstrokes.

set-up the register pairs HL, DE, BC, and HL' to point to two regions in RAM memory that will contain the incoming and outgoing keyboard data.

Here is what will happen. When an INT occurs, a keyboard character will be placed at the end of a queue in the inbuffer. The pointer to this queue (in HL') will be increased by one byte and a 0 placed in that memory location. When the Z80 is not getting more characters from the keyboard and placing them in the inbuffer or sending them to the main computer by reading from the outbuffer (see below), it is checking if its pointer to the character in the inbuffer is zero. If it is not, it assumes one or more new characters have arrived. These characters are read from the inbuffer, translated if need be (see below), and placed in the outbuffer. The pointers to both buffers are updated accordingly and a zero flag in each buffer is set to indicate the ends of the buffers. It is important to remember that this is all this Z80 will ever have to do. So, certain registers can be set aside permanently to hold certain values. The code is shown in Listing 4.

The subroutine TRANS is the heart of the code. It takes the bit pattern from the keyboard and translates it into ASCII characters. This is necessary because the IBM/Keytronics keyboards sends only a binary number representation of the key pressed, not the ASCII character. For example, the ESC key sends 01H, the "I" key 02H, etc. Further, the keyboard distinguishes between key down-strokes and key up-strokes. Up-strokes have the same binary number plus 80H. In other words, their most significant bit is set. This is not all as bad as it sounds. It means we must make a lookup table of ASCII characters from binary values. Figure 3 shows the way the keys are numbered on an IBM/Keytronics keyboard. Part of the corresponding table looks like:

```
ITEMBL: DB      0
        DB      1BH, '1234567890-=', 8H
        DB      9H, 'qwertyuiop[]', 0DH
        DB      42H, 'asdfghjkl;', 27H, 60H
        DB      41H, 'zxcvbnm,./*', 41H, '**'
        DB      1EH, ' ', 44H
```

When TRANS arrives, with say a 02H in register A, the actual ASCII value is obtained by adding 2 to the [HL] register

pair which is pointing to the start of the table. Then an instruction:

```
LD      A, (HL)
```

places the correct ASCII character in register A. The code for TRANS is as shown in Listing 5.

For the Smart Keyboard to be of use, we need a number of tables of the type described above. This is because the meaning of a key-board character can change, depending on whether keys such as the shift, lock, NUM or control keys were previously pressed. Each time one of these keys is pressed the appropriate flag is updated in RAM to set our [HL] pointer to the appropriate table. Rather than present all this code, I have sent it to the public domain SIG/M library. The file SKEY.Z80 contains all the code described in this article.

Besides the above special keys, which almost every keyboard has, we can add new ones. For example, we might have a case in which the F1 key is pressed; we have TRANS point to a table which defines the keys of the number keypad as special control sequences for a word processor such as Wordstar. F2 would point to a different table for a text editor such as Vedit. For complete compatibility with the IBM-PC, we can have a table where untranslated information (binary key numbers) is sent to the BIOS of the computer and translated exactly as IBM describes.

Now for the most important feature of the board — single-key to multi-key translation. If TRANS observes that the translated key is greater in value than 7FH (bit 7 high), another routine which I have named MULTI, is called. This routine looks at the "special character" and depending on its value, places not one, but a string of characters in the outbuffer. This string is then read by the main computer which thinks they were individually typed. To give you an example: If I press the "F6 key" TEST.TXT on my keyboard - 9 key strokes + CR, the computer would receive VEDIT TEST.TXT. At the same time, the numeric keypad would be automatically configured for the Vedit cursor/editing control sequences. This is done by pointing TRANS to the appropriate lookup table.

Because we have the power of a micro-processor at our disposal, we can do a lot with one keystroke. For example, I like to have the same cursor control keys for all my editors and word processors. Vedit uses one control character in many situations in which Wordstar uses two. In fact, in some cases, one needs to toggle two sets of dual control characters in Wordstar to get the same effect as with Vedit. This can be easily accommodated with this setup. The routine MULTI is quite long and contains a number of special-case treatments for special keys. There is not room here to present the whole routine. However the kernel of the routine is shown below in Listing 6.

In this routine, two data areas are used. Multi\$table contains a list of pointers to the first character of each string. The offset into multi\$table X2 will allow the correct pointer to be picked up. This in turn points to the actual string which can be of varied length. A simplified version of the table is shown in Listing 7.

The DROP routine then transfers each character of the string into the outbuffer until a 0 is reached.

One final point. When you are finished with your special application program, it would be nice to reset the keyboard back to its default configuration (CP/M or MS-DOS). It would be nice also not to have to do this manually. This is where I have utilized the NMI line to the Z80. Whenever this line is pulled low, the Z80 stops whatever it is doing and jumps to 66H in RAM where it finds the code shown in Listing 8.

Now, while this is not entirely clear unless you read the complete code, suffice to say, all flags set up in memory are reset to their initial power-on (CP/M or MS-DOS) configuration. How does the NMI line get triggered? This is where you have to use your own initiative. In my S-100 system, I use one bit of an output port to lower and then raise the NMI line on the Z80 board. In the BIOS portion of CP/M+ and CP/M86, one can put the required code in the warm-start module just before control is transferred to the CCP.

For MS-DOS, I utilize the fact that the command-line prompt is definable. For example it could be "A>" or "A\$". I set it to "Esc Esc A>". When my console output driver sees the unique "Esc Esc" sequence, it sends a signal to the smart keyboard to pulse the NMI line of the Z80. There are many other possibilities. Many editors have logoff control sequences, indeed, you could set aside one keyboard key for the function.

Lastly, the power of the Z80 in this application is hardly used. You can easily modify the design to use keys to switch-on drive motors, CRT's, or to restrict access to certain programs. I have mine connected to a speech synthesizer that sends me all kinds of information and reminders. (P)

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LISTING 1

OUTBLOCK:	LD	HL, PIOTBL	;POINT TO THE PIO TABLE
	LD	A, (HL)	;GET BYTE COUNTER
	OR	A	;TEST FOR END OF TABLE
	JR	Z, ALLSET	;0 WHEN ALL PORTS DONE
	LD	B, A	;ELSE PUT COUNT IN B
	INC	HL	;POINT TO PORT #
	LD	C, (HL)	;PUT PORT IN [C]
	INC	HL	;POINT TO FIRST DATA VALUE
	OTIR		;SEND 2 BYTES TO PORT IN [C]
	JR	OUTBLOCK	;GO TO NEXT PORT.

Continued on next page.

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systems. He has been a member of the Amateur Computer Group of New Jersey for over 9 years and recently moved to the San Francisco bay area. He can be contacted at: Box 1908, Orinda CA 94563.

LISTING 4

```

LOOP: LD A,(HL) ;SEE IF ANYTHING IN INBUFFER
      OR A
      JR Z,LOOP1 ;IF NOTHING CHECK OUTBUFFER
      INC L ;INCREASE POINTER FOR NEXT TIME
      PUSH HL ;SAVE THESE REGISTERS
      PUSH BC
      CALL TRANS ;CONVERT BIT PATTERN TO ASCII CHARS
      POP BC ;RESTORE REGISTERS
      POP HL ;DO NOT SEND NULLS TO MAIN COMPUTER
      OR A
      JR Z,LOOP1 ;FLAG TO INDICATE SPECIAL CASES
      BIT 7,A ;IF Z THEN SIMPLE ONE TO ONE
      JR Z,NORMAL ;NEED TO SAVE IT AGAIN
      PUSH HL ;ONE IN CHAR TO SEVERAL OUT CHARS
      CALL MULTI
      POP HL
      JR LOOPM

;NORMAL: LD (DE),A ;PUT ASCII CHAR IN OUTBUFFER
      INC E ;FLAG END WITH ZERO
      LOOPM: XOR A
      LD (DE),A

;LOOP1: LD A,(BC) ;ANYTHING TO SEND TO
      OR A
      JR Z,LOOP ;NOTHING THERE BACK TO INBUFFER QUEUE

;LOOP2: IN A,(DATA$D) ;IS COMPUTER READY FOR NEXT CHAR.
      BIT 0,A
      JR NZ,LOOP2 ;HANG IN THERE UNTIL READY
      LD A,(BC) ;[BC] POINTS TO CHAR
      INC C ;FOR NEXT TIME
      OUT (DATA$A),A ;SEND IT
      JR LOOP

```

LISTING 5

```

;TRANS: LD HL,SHIFTFLAG ;POINT TO FLAG OF CURRENT SHIFT ETC. MODES
      BIT 7,A ;IS KEY AN UPSTROKE MOVE
      JR NZ,UPSTROKE
      CP SHIFT1 ;IS IT A SHIFT KEY
      JR Z,ISSHIFT
      CP SHIFT2 ;TWO SHIFT KEYS ON BOARD
      JR Z,ISSHIFT
      CP SHIFT3 ;FOR SHIFT LOCK KEY
      JP Z,ISLOCK
      CP NUMLOCK ;IS IT NUMBER LOCK KEY
      JP Z,ISNUM
      CP CTRL ;IS IT THE CTRL KEY
      JP Z,ISCTRL
      PUSH AF ;SAVE CHARACTER FOR THE MOMENT

; LD A,(HL) ;FIND OUT WHICH TABLE IS CURRENT
; BIT 6,A ;BIT 6=1 FOR WORDSTAR TABLE

; NOTSTAR: BIT 4,A ;BIT 4=1 FOR VEDIT TABLE
      JR Z,NOTVED
      LD HL,VEDITABLE
      JR ENDSHIFT
      NOTVED: BIT 5,A ;BIT 5=1 FOR IBM/DOS KEYBOARD
      JR Z,NOTIBM
      LD HL,IBMTABLE
      JR ENDSHIFT
      NOTIBM: LD HL,CPMTABLE ;X000XXXX = DEFAULT TABLE TO CP/M TABLE

```

```

;ENDSHIFT: AND 00000010B ;IS UPPER OR LOWER SECTION OF TABLE REQ
      JR Z,UPPERHALF ;BIT 1=1 FOR UPPER CASE CHARS (!@#$...)
      LD B,0
      LD C,HALF
      ADD HL,BC ;HL NOW POINTS TO SECOND HALF OF EACH TABLE

;UPPERHALF:
      LD B,0 ;GET CHARACTER BIT PATTERN
      POP AF
      LD C,A
      ADD HL,BC ;GET OFFSET INTO TABLE
      LD C,(HL) ;STORE CHARACTER BACK IN [C]
      LD HL,SHIFTFLAG ;NOW NEED TO SEE IF WE NEED SHIFT MODE
      LD A,(HL)
      AND 00000110B ;SEE IF a....z TO UC IS REQ
      JR Z,ENDSHF ;BITS 1 OR 2 =1 FOR UPPER CASE
      LD A,C
      CP 'a'
      JR C,ENDSHF ;ARE CONTROL CHARACTERS REQ.
      CP 'z'+1
      JR NC,ENDSHF ;BIT 3=1 FOR CTRL CHARS.
      SUB 20H
      LD C,A
      LD 3,(HL)
      LD A,C
      RET AND 00011111B ;NONE THEN NORMAL RELAISE
      RET

;UPSTROKE: CP UPSH1 ;WERE ANY SPECIAL KEYS RELEASED
      JR Z,NOTSHIFT
      CP UPSH2
      JR Z,NOTSHIFT
      CP UPCTRL
      JR Z,NOTCTRL
      XOR A
      RET

;ISSHIFT: SET 1,(HL) ;IS SHIFT KEY SET FLAG
      XOR A
      RET

;ISLOCK: XOR A ;TOGGLE CAPS LOCK ON/OFF
      BIT 2,(HL)
      JR Z,TOGGLE
      RES 2,(HL)
      RET

;TOGGLE: SET 2,(HL)
      RET

;ISNUM: BIT 0,(HL) ;THIS HAS TOGGLE INFO FOR NUMLOCK LED/BIT
      JR NZ,TOGG1
      LD A,(HL) ;IF 0, FORCE IBM TABLE
      AND 0000110B ;SO NEXT TIME CP/M TABLE
      OR 00100001B
      LD (HL),A ;call cleanflags
      call HL,SPIEM ;CLEAR VEDIT & WS FLAGS
      CALL TALK
      XOR A
      RET

;TOGG1: ID A,(HL) ;IF 1, FORCE CP/M TABLE
      AND 0000110B ;NOTE BIT 0 ALSO SET TO Z
      LD (HL),A ;call cleanflags
      call HL,SPCPM ;CLEAR VEDIT & WS FLAGS
      CALL TALK
      XOR A
      RET

```


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The CP/M Bus

by Robert A. Blum

The CP/M Bus Bulletin Board System, operated by Bob Blum, is available for your use 7 days a week, 24 hours a day at 1200 baud. Reach it by calling (404) 449-6588.

Gaining enough experience to easily maneuver about the CP/M Bus Bulletin Board system, or any other BBS for that matter, can be a very time consuming project. Evidence to this fact is brought to my attention practically every day by way of questions that are left on my BBS system. And contrary to what you might think, many of the questions come from experienced users confused by the subtle differences that exist between BBS systems.

The root of this problem stems from the numerous ways that the same basic set of system control programs operating on most BBS systems can be configured by the System Operator (SYSOP) to suit their particular needs. For example, most SYSOPS want their system to be as impervious to abuse as possible while still providing the caller complete access to the treasures within. To this end, some SYSOPS demand complete control over system access by requiring users to pre-register by mail or phone before entry to the system is allowed. On the other hand, SYSOPS like myself don't want to deny system access to anybody that has at least a working knowledge of CP/M and can answer a question or two while online about its standard components.

As I've already said, either type of system can be setup using the same set of programs; but to a large degree, how the system responds to your commands will differ from system to system. Of course, this does not pertain to every system in operation. There are probably as many different programs running BBS systems as there are SYSOPS, but the majority of them will have at least some common commands and a comparable feel.

To get a basic understanding of what is needed to access a BBS and what some of their differences are before committing yourself to the phone company, one should read a reference book.

THE FREE SOFTWARE CATALOG AND DIRECTORY

Public Domain Software is software that can be legally copied and used and given to another without payment of a royalty to its author.

Estimates project that over 40 megabytes of program source code is contained on the 300+ volumes of CP/M public domain software. In this vast library can be found just about any type of utility program that you might need to help manage your CP/M system. And a number of business application programs, mostly written in Cbasic, are present as well.

Until now many would-be avid public domain software users have been stymied by the thought of contending with the over 5000 program titles in order to find just the few desired. Fortunately, Robert A. Froehlich, a long term member of SIG/M and avid user of public domain software, foresaw this problem and has compiled a reference book detailing and indexing each program.

The Free Software Catalog And Directory is a 475 page 8½ X 11" book printed on newsprint stock focusing on the two largest and most readily available free software libraries, the CP/M Users Group (CPMUG) and the Special Interest for Microcomputers (SIG/M), and provides all the information necessary for personal computer owners to take advantage of this resource.

The introduction begins by setting aside any fears one might have about using public domain software. It concludes by talking a little about the main sources of free software. But most important is the elaborate tutorial, the best I have seen, of successfully completing a session with a Remote Bulletin Board System (RBBS). This section in itself makes the book a worthwhile investment for the novice and experienced user alike. The remainder of the introduction prepares the reader for dealing with source code files and how to go about making changes to them should that be necessary.

The real meat of this book is contained in the next six sections. Every file in the entire 92 volume set of the CPMUG library and the first 162 volumes of the SIG/M library are described in detail. The first and second sections are the largest in size because complete information for each file is included as follows: file name, size in K bytes, CRC checksum, date of entry, language if program source code, authors name, revisors name, file title, keywords assigned to this file and finally a textual description of the file.

But, of course the main purpose of this book is to provide ready access to information about the routines or programs of

interest to you. The next four sections cross reference each file alphabetically by keyword, language type, author name, and lastly by file name. For example, if you wanted to find a program to compare two files for equality your initial search might start in the keyword section under utilities. Found there are two entries; the one for comparing binary files sounds like it would serve well; it is on SIG/M volume 115. Thus, a complete description of the chosen file can be found by referring to the second section of the book completely describing each SIG/M volume.

As if all this weren't enough, the book concludes by listing several hundred User Groups and bulletin board systems by name, location, and phone number.

This book has become the most used of any in my bookcase. It is a tremendous bargain at \$9.95. The author has accomplished a phenomenal task in compiling this much material and cross indexing it for ease of access. No matter whether you are an individual user of free software or the librarian of a user group you will benefit from having the book.

If you're having trouble finding a source of free software in your local area call the CP/M Exchange RCP/M system at (404) 449-6588. There you will be able to view a list of user groups where public domain software can be found.

MAKING CP/M BETTER

From Neil Harrison of London, England comes the following letter describing his endeavors at making CP/M and ZSID better programs:

I have been running the Plu*Perfect Systems Public patches for the CP/M 2.2 BDOS for a few months now and really find them a great help on my hard disk system. I have a suggestion for people using the Public file system which they may find useful.

One thing that has occasionally been a source of annoyance over the years is the inability of a Submit batch job to continue after changing the user number. The reason for this is fairly straight forward; when the user number gets changed the \$\$.SUB file which contains further commands gets *left behind* in the previous user and the CCP fails to find it. Only when you return to the original user where the Submit job was started does the batch processing continue.

Press RETURN for more; type NO to stop:

The answer to this problem is for the

CCP to be able to find the \$\$.SUB file from any user, i.e. for it to be a Public file. Now, since Public files are simply distinguished by having the F2 attribute bit set (bit 7 of the second character of the filename) all that is required is for SUBMIT.COM to be patched to create \$\$.SUB with this bit set. The single byte patch to accomplish this is outlined in Listing 1.

The idea behind this patch should apply to all the superior Submit replacements that are in the public domain. Simply find the ASCII string "\$\$.SUB" in memory using DDT and set the most significant bit on in the second "\$".

Much of what I write is still in Z80 assembler language and so ZSID is an important tool for me, giving Zilog nomenclature and full Z80 tracing. However, the format of the memory dump command in ZSID has always irritated me. Hex and ASCII data are displayed on alternate lines which limits the screen width required (my guess is that the author of ZSID only had a 64 column screen). This means that only half as much memory can be displayed at a time compared with the display format used by DDT where hex and ASCII are on the same line.

I recently got around to patching ZSID to give the same memory dump screen as DDT. Only five bytes are involved as outlined in listing two. Before making these patches to ZSID examine listing three, an example of the results, to determine whether you want to proceed. I was concerned not to cause problems with the relocation technique used by Digital Research so when patching out calls to subroutines rather than substituting NOPs which might then be modified I simply made the call address that of a return instruction.

Thanks Neil! Since DRI no longer supports CP/M utilities, patches like these are very important. If you have something useful please send it along. Talk to you next issue. μ



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Listing 1 - SUBMIT.COM PATCH

Address	Old Data	New Data
05BB	24	A4

Listing 2 - ZSID PATCH

Address	Old Data	New Data	Notes
125F	5F	BF	default number of bytes displayed-1
12C1	D1	85	was call to CR/LF subroutine
12C4	06	01	spaces between hex and ASCII
12E2	77	85	was a space between ASCII characters
12E5	77	85	was a space between ASCII characters

Listing 3 - ZSID PATCH RESULTS

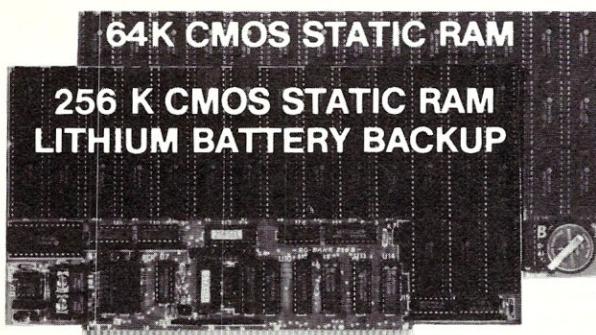
Before:

```
0100: 01 F9 21 C3 3D 01 43 4F 50 59 52 49 47 48 54 20
. . ! . = . C O P Y R I G H T
0110: 28 43 29 20 31 39 37 37 2C 20 44 49 47 49 54 41
( C ) 1 9 7 7 , D I G I T A
0120: 4C 20 52 45 53 45 41 52 43 48 20 20 20 20 5A
L R E S E A R C H Z
```

After:

```
0100: 01 F9 21 C3 3D 01 43 4F 50 59 52 49 47 48 54 20 . . ! . = . C O P Y R I G H T
0110: 28 43 29 20 31 39 37 37 2C 20 44 49 47 49 54 41 ( C ) 1 9 7 7 , D I G I T A
0120: 4C 20 52 45 53 45 41 52 43 48 20 20 20 20 5A L R E S E A R C H Z
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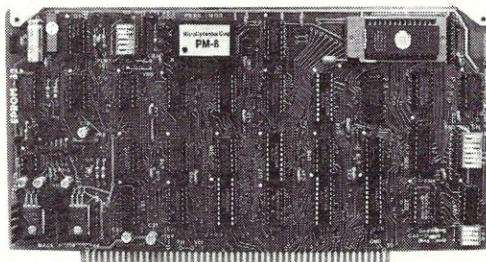
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See Dec. 1983 **Microsystems** for a review of the EPROM-32.

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Phoenix' PFIX-Plus Debugger

by Randy Davis

Phoenix Computer Products Corporation has long been known for its professional software utilities for MS-DOS machines. Such Phoenix utilities as PLIB86 and PLINK86 start with capabilities already included in DOS, and add significant features to bring them up to the level expected by professional programmers. In similar fashion, PFix86-plus starts with, but goes far beyond, the simple capabilities of the DOS supplied DEBUG utility.

The Phoenix debugger is available in two different forms, the standard PFix86 and the enhanced PFix86-plus. The two debuggers are identical, even sharing the same manual, except that the -plus version includes the ability to read and use a symbol table. Rather than confronting the user strictly with hexadecimal addresses as DEBUG does, PFIX-plus replaces hex addresses with labels wherever it can. This aids tremendously in understanding the disassembled listing appearing on the monitor. I will only be discussing the enhanced -plus debugger, although everything said, except for references to program labels, applies equally well to the standard version.

THE PACKAGE

PFix86-plus comes in an attractive 3-ring hard back binder, roughly the same size as the DOS manuals. Enclosed within the manual are the standard registration papers and a single system diskette. The shrink wrap license is the standard *one machine* agreement. Thankfully the PFix system disk, including the debugger itself, is not copy protected. Included on the system disk is an example configuration file, some added utilities and a READ.ME file containing the most recent errata, including errors in the PFix manual.

Along with both a table of contents and an index, the manual contains well written chapters dedicated to installation of the software, principles of operation, and the meaning of the various debugger commands. Due to the profusion of debugger commands and the insistence on the manual's part of explaining separately each and every one, the manual seems much larger and cumbersome than it needs to be. How-

ever, appendices containing debugger command summaries also appear at the end of the manual for quick reference. I had difficulty with the tutorial chapter since it did not seem to completely match the example program on the system disk.

One other problem: I did not feel that Phoenix spent sufficient time describing the use of their powerful breakpoint facility. Further, the configuration file includes the ability to adjust some rather critical parameters; however, without more information, few will venture to try it.

THE PFIX DEBUGGER

PFix consumes roughly 60k of system memory, not a large appetite by today's standards. The debugger appears to write to the screen using direct screen I/O. Although this necessitates highly IBM compatible hardware, screen updates become practically instantaneous. PFix will work with two displays, if present, by using one as the debug screen and the other as the user program screen. Although this works very well, PFix works almost as well on a single monitor system by saving off the user screen when at a breakpoint and maintaining the debugger display in the background when the user code has control.

The PFix debugger itself consists of two files: the PFIXPLUS.EXE and an ASCII configuration file called PFIX.CFG. By editing the .CFG file the user has some flexibility in configuring the debugger for his particular desires. For example, the NEC V20 in my PC confused PFix into thinking that it was running on an 80286 processor, like that in the AT. A quick edit of PFIX.CFG forced the processor type to 80186, the available option most similar to the V20 in instruction set.

Commands are entered on a command line, very similar to that made popular by Lotus in 1-2-3. The sliding inverse video bar provides a form of on-line help, making PFix almost self explanatory. To facilitate quick entry, the most common commands are accessible by the function and Alt keys. This is fortunate as the many available options often make it necessary to traverse several levels of menu before the desired command may be completed.

There is one unfortunate difference between PFix' command input and that of Lotus. Once a command has been completed, PFix immediately puts you back at the *root* level, rather than leaving you at the *current* level. This often necessitates needlessly climbing back down the same command path multiple times.

One of the primary areas of any debugger is that of breakpoints. PFix allows for up to 10 temporary and 10 permanent breakpoints. Temporary breakpoints are like those found in DEBUG, all breakpoints being removed when any one of them is encountered. Permanent breakpoints remain, however, until specifically removed. Permanent breakpoints may be enabled or disabled. In addition, permanent breakpoints can have loop counts and may be conditional. For example, the user might specify to stop on the fifth time that a certain instruction is executed with the AX register set to 0.

PFix understands logical operators. This makes it possible to write complex conditions, such as AX=0 and BX \neq 0, or stopping for the result of a particular calculation that has a particular value. Apparently, the programmer can get quite creative in this area. Since the manual does not go into great detail, I do not know what the limits of complexity of the conditional might be.

Permanent breakpoints need not break to the debugger screen when encountered; other options are to call a user provided routine, enable another breakpoint or disable another breakpoint. As an example of this type, suppose that I had a function which gave problems whenever it was passed an input value of 0. I could set a breakpoint at the point where the function messes up, and disable it. I would then set a second breakpoint at the beginning of the function, which would enable the first breakpoint if it saw an input value of 0. This type of *cascading* of breakpoints is very helpful in locating bugs which only occur infrequently.

An unusual type of breakpoint, which Phoenix calls a global breakpoint, may be specified. Global breakpoints do not specify an instruction location, only a count and a condition. When such breakpoints exist,

PFix single steps the user's program, checking for the condition after each instruction. For example, suppose I know that a particular memory location is being cleared erroneously, but I don't know from where. I can set a global breakpoint "proceed until location xxxx is zero". My program will execute one instruction at a time with PFix keeping a constant vigil on that location. Even though my program executes much slower this way than it otherwise would, this method is hundreds of times faster than if I must manually single step the program, while watching the location myself.

One of PFix' greatest powers lies in its ability to manipulate symbols (as mentioned earlier, here we are only discussing PFix-plus). A program linked with Phoenix' PLINK86 (not included) can optionally contain a symbol table within the executable .EXE file. Bring up such a program from PFix, and the symbol table is loaded automatically. No longer must I specify an address in the form, 1234:5678; I can now specify CODE_SEG:MY_PROG, or any other label from within my program, and the debugger knows exactly what I mean. Further, by referencing such symbols, breakpoints may be set in overlays, even if the overlay containing the breakpoint address is not currently loaded into memory.

Much to Phoenix' credit, PFix does not require the use of PLINK86 to take advantage of its symbolic capabilities. The PFix system disk includes a utility, ADDSYMS, which can take the .MAP output file from the standard DOS linker and combine it with the .EXE program file. When brought up under the debugger, PFix contains every symbol which appeared in the linker's map file. Although such a combined file can also be executed normally from DOS (which will ignore the symbol information), a second utility, SYMTABLE, has been provided to strip the symbol table from a working program without the need to relink. (Note that those who use the PLINK86 linker need only include the /SYMBOLS switch to include symbolic information in the .EXE file.)

Once in the debugger, symbols may be added (or removed) manually. For example, once I have narrowed a problem down to a particular area, I might set a label, say TROUBLE_SPOT, at that location. With this label I can easily return to the location of the problem. PFix will not write the edited symbol table back out to the .EXE file, but it will write a separate symbol table file, which can subsequently be reloaded. This ability to create labels is also a great aid when debugging code to which I do not have the source.

When stepping through a program, PFix gives the operator two options, trace and single step. Single step works exactly like the T command in DEBUG, executing

the next single instruction (actually the number of instructions is adjustable and need not be 1) and then returning control to the debug screen. Often times, however, the user would like to stay within the current routine, treating a call to a subroutine or a system call to PC-DOS as one instruction, not halting until after control has been returned to after the call. The PFix trace feature offers just this option. Trace also works for the instructions which perform more than one function (such as REP MOV, PUSH, etc.). For convenience, the trace and single-step, as well as the set temporary breakpoint, are accessible via special function keys.

When using PFix as a debugger, you can compile and link your programs normally. However, since neither the Phoenix PLINK86 linker nor the PC-DOS linker include symbols unless told to, you will at least need to add a few switches to your link step to fully utilize the symbolic features. Many compilers will also require switches during the compilation step to add symbol information to their output.

Unfortunately, Turbo Pascal will not generate a .EXE executable file and cannot include symbol information. C defines that all procedures declared are automatically public, unless specifically marked otherwise; therefore, C symbols are included automatically. Assembler source routines should have a PUBLIC directive for each symbol which the user wants PFix to know about. Many compilers will optionally include source code line numbers as symbols (Lattice C compiler generates such symbols if the -d switch is used). The documentation for each compiler will explain how to include symbol information in the object file.

The DOS linker must also be persuaded to include this information in the executable file. First, the default is for the linker to not generate any .MAP file. This must be overridden by providing a name to the prompt "Map file [NUL]:". Adding the /Map (or /M) switch to the link command includes procedure names in the .MAP file. Add the /Line or (/L) switch for inclusion of line numbers. Once generated, the .MAP file information is included into the .EXE file using the Phoenix supplied utility ADDSYMS mentioned earlier.

CONCLUSION

I used PFix for several weeks before beginning this review to familiarize myself with its features. Being something of a hacker, I had several programs lying around, waiting for those last bugs to be driven from them. One assembler program, in particular, had a bug which had already eluded many hours of assault from DEBUG. After reassembling, with PUBLICs inserted for the main symbols I needed, and relinking with the /M switch, I

applied PFix to the miscreant program. The bug had been found and permanently banished from my program within the hour!

Overall I found PFix to be an excellent program debugging tool. It provided all the abilities one would expect of a *professional package*. It never crashed even when performing some pretty tricky stunts. PFix puts a tremendous amount of debugger power at the user's disposal. Even though the layout of the special function keys seemed completely arbitrary to me and I have yet to be able to remember them, this seems like a picky point. I guarantee that anyone who uses the PFix-plus symbolic debugger will never return to simple DEBUG. 

Mail

continued from page 26

teresting CP/M computer because of the sound and graphics capabilities. I had no problem using the sound and graphics capabilities of the C-64 from CP/M. The C-128 added another video chip that emulates the IBM-PC color display abilities. Very little software takes advantage of it yet. Currently, the C-128 has 128K in CP/M mode. Commodore is planning to produce a memory expansion cartridge that can be used as a RAM disk in CP/M mode.

Respectfully,
Glynn E. Stafford, Jr.
Waldorf, MD

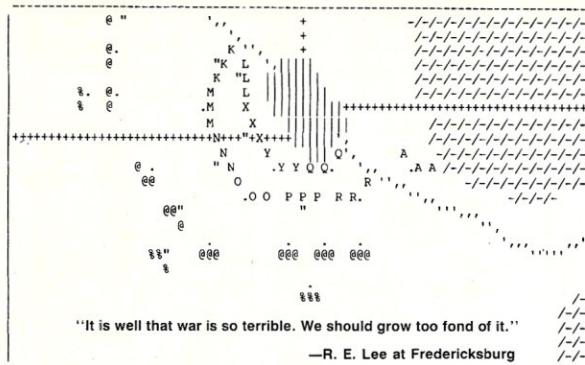
FUTURE ARTICLE TOPICS

Dear Sol,

I am glad to see the magazine is still surviving; I hope it grows until it positively flourishes. There are still a lot of things I would like to see. For a start, the series of graphics standards that the old rag was running when it folded was a Good Thing. It is a difficult area to get into unless you have someone fresh out of college to help or are in a big firm that can afford to make mistakes. I fear half your problem would be finding people capable of writing this type of article. Information on Concurrent in all its forms is welcome as well. It is becoming the multiuser operating system and is very popular over here (40% of DR's business is outside the States!).

I suspect that a large part of your readership are professional developers; the conditions that spawned the hackers have disappeared in the new era of regimentation. But, they are certainly enthusiastic professionals, and the options for producing more polished and professional systems are opening out fast. I personally am trying to decide whether to go for GEM or Windows. A series of articles comparing development with each of these and with Topview would be fascinating. Hints as to what works well for the user would be as interesting as technical information on using the toolkits.

Justin Smith
London, England



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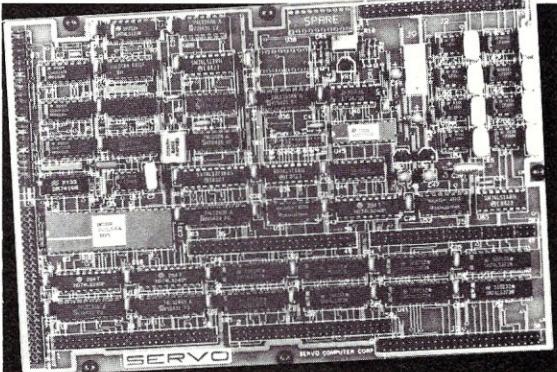
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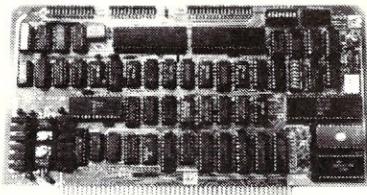
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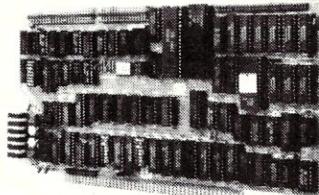
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The Holliston Challenger XT-186

by Charles H. Strom

Leafing randomly through the pages of any of today's microcomputer-oriented periodicals, one is faced with a plethora of IBM PC-compatible system boards. Many strive to be just like IBM; others add a feature or two such as 640Kb of RAM on the board, dual speed operation, etc. A few have gone a step further in an attempt to attain performance improvements while minimizing incompatibilities with the existing base of IBM-specific software. One such board is the Challenger XT-186, made by Holliston Computer, Box 615, Chepachet, R.I. 02814 (401-568-0522). We had the opportunity to use this board for several weeks and have prepared this report on its performance.

THE LAYOUT

The Challenger is dimensionally identical to the IBM-XT system board, so it slips in easily. We have been testing the board in a clone system consisting of the Challenger, a monochrome video card, floppy disk controller, DTC hard disk controller with a CMI 6426 drive, and a serial/clock-calendar board. The system board is based on an 80186 running at 8MHz (10MHz is an extra-cost option) with 640K of parity-checked RAM taking advantage of the true 16-bit wide data path afforded by the CPU. There are eight expansion slots available, six of which are PC-compatible. The two additional slots are quasi-AT compatible. Not all of the address lines are brought out to the connector and Holliston is currently investigating the usability of various AT compatible extended memory boards. We did not have an opportunity to use the extended slots, but the PC-type slots appear to be pure clones. There is no 8087 socket; however, a small piggy-back board is available.

The XT-186 has two sockets for system ROM; since it employs a true 16-bit architecture, it is not possible to substitute IBM or clone ROMs. Fortunately, virtually no problems with the XT-186 BIOS were experienced. With a few exceptions noted below, all software ran flawlessly. An optional ROM has recently been announced by Holliston. It supports the IBM AT combination floppy/hard disk controller and thus allows

the use of 1.2Mb floppies as well as two hard disks. Unfortunately, we did not have the opportunity to test this ROM.

PERFORMANCE

The best way of assessing the utility of the board is to put it to everyday use. The Norton Utilities system benchmark reports speed equivalent to 4.2 PC's. A more meaningful benchmark is the famous Sieve of Eratosthenes. Paul Homchick, our co-sysop on the GENIE IBM Round-table, created a stand-alone program that finds 1899 primes and displays the elapsed time. Here are a few representative results of this compute-intensive benchmark relative to an XT:

IBM PC-XT	1.00
Compaq	1.65
CompuPro (8088)	1.78
AT&T 6300	2.10
AT&T 6300 (V30)	2.62
IBM PC-AT	3.19
Holliston XT-186	3.07

Clearly, the XT-186 is a respectable machine in the speed department. The only issue remaining is compatibility. Both MS-DOS 2.1, and 3.1 for the IBM PC, boot up with no difficulty at all; virtually all *well-behaved* applications and utilities perform correctly. This includes classics such as WordStar, DBase III (Holliston reports a problem with DBase III Plus which they are investigating), etc., all of the MS-DOS utilities, and the dozens of public domain and shareware programs we have used while we have had custody of the XT-186.

It is much simpler a matter to describe the incompatibilities as they are few in number. Several programs, such as CopyWrite by Quaid and earlier versions of Media Master (a format translator) talk directly to the floppy disk controller and fail with the XT-186. Holliston explains that this is caused by too rapid an execution of closely-spaced I/O instructions (due to the high speed and instruction caching of the 80186) causing overrun on the peripheral device. The matter is simple to resolve if source code is available, but that of course is not the case in the above-mentioned examples. Intersecting Concepts has updated Media Master to run

on an AT. This enhancement also allows proper operation on the XT-186. CopyWrite is written specifically for the PC and XT and not the AT. Therefore, without provisions to insert software delays at strategic places, CopyWrite will not run correctly. It would be useful to include a hardware or software switch to allow a slow mode of operation for such extremely hardware-dependent applications, but there is no such feature on the XT-186. If a package is designed to run on an AT, there should be no timing problems on the Holliston board.

Another incompatibility we discovered is with Digital Research's Concurrent PC-DOS version 4.1; attempting a boot yields a memory parity error and subsequent program halt. This is unfortunate, as we feel that CPCDOS is a natural for high speed operation. The overhead of multiuser, multitasking operation afforded by CPCDOS leads to slow operation on a stock PC. We use this operating system routinely with a 9.5MHz 8086-based accelerator card and a similar, acceptable system speed would be experienced with the Holliston board as well. We seem to be in the minority in our fondness for CPCDOS; in fact our mere mention of it is often met with raised eyebrows by the bulk of PC users. Thus, this incompatibility should not be a critical one for most users.

THE BOTTOM LINE

Prices for the XT-186 are reasonable. As of this writing, an 8MHz system board populated with the maximum of 640K of RAM lists at \$595, or \$495 without memory. A 10MHz system costs an additional \$150 (well worth the incremental expense in view of the 25% speed improvement). The AT-compatible ROM is an option priced at \$50. The cost of the 8087 piggy-back board has not been firmed-up as of press time.

In summary, the Holliston Challenger XT-186 is a board to consider if you want to upgrade your PC or XT system to AT performance. With the same form factor as the PC/XT boards, it's an easy replacement providing superior performance with minimal sacrifice of compatibility and does not require any change of software or operating habits. [u]

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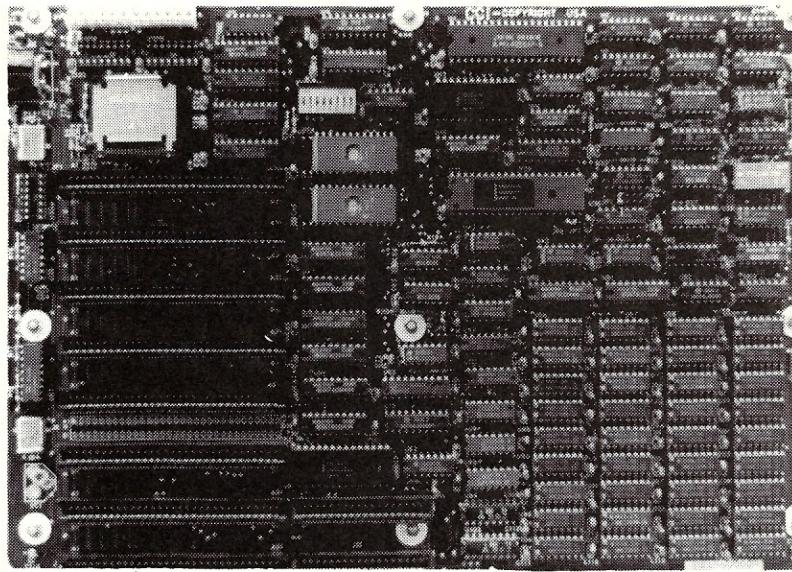
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- ROM BIOS Version 2.0



The Challenger XT-186 offers full IBM PC-XT compatibility. It supports industry standard operating systems: MS-DOS, PC-DOS, 1.0 through 3.1, CP/M and runs all existing software with higher performance. The XT-186 mother board can directly replace any existing PC or PC-XT mother board, as it has the same physical dimensions and mounting holes. The Intel 80186 and 640K on-board 16 bit path RAM makes the XT-186 the fastest PC currently available.

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Program Interfacing To MS-DOS

by William G. Wong

This article presents a real example of a loadable DOS device driver using the information described in the previous articles. The driver is for a memory disk (often referred to as *virtual* disk or RAM disk) which is a block device. The next article will present a character device driver.

A memory disk turns out to be a good example because it is readily implemented on any DOS system. A memory disk uses the processor's main memory to emulate a disk drive. The advantage is its transfer rate which is 10 to 100 times faster than a hard disk. The disadvantage, typically, is that this disk is volatile, and it uses up the memory resources which may be required by application programs. Both disadvantages can be overcome using hardware support, such as battery backup power supplies, and separate memory boards that can extend the memory systems to as much as eight megabytes of storage. However, specific support for these devices will not be presented here.

Macros were not used for portability. The source was assembled using the Microsoft Macro Assembler but any 8086/8 assembler should work. The object file was linked and converted to a .COM file format program. The origin of the program is 0 as opposed to 100 hex for normal .COM files. The file type of the resulting executable file was named MDISK.SYS.

The MDISK.SYS file is included on the boot disk and the following line of text is included in CONFIG.SYS, also on the boot disk.

DEVICE=MDISK.SYS

That is all that is required to use the memory disk drive on a DOS 2.x system.

The driver source is included at the end of the article and is referenced throughout. The source code is divided into four sections. The first contains device independent constants and definitions including offsets to various structures and values which may be placed into these structures. The second section defines common structures and variables used by all device drivers. The BIOS Parameter Block (BPB) structure is common to block devices although it contains device specific values. The third section contains source code which is common to all device drivers. The first three sections can easily be extracted from the memory disk source

Part VIII A Memory Disk Device Driver

and integrated with support code for other devices. In fact, these three sections will be used in the next article which supports a character device. The fourth section contains the code specific to the memory disk. It also includes the device specific variables and structures except the BPB which is in section two.

The assembly code is structured using CALL and RET instructions to access and terminate functions. Any jumps are within a function and implement conditional code segments or loops. Opcodes are normally positioned one tab position to the right of the left margin. An additional space is included if information is pushed on the stack. The space is not included after information on the stack has been removed. For example:

```
push    ax    ; save some registers
push    bx    ; on the stack
call    foo   ; do something
pop    bx    ; restore to registers
pop    cx
```

For those unfamiliar with the 8086 architecture, there are two types of call and return instructions, long and short. The long versions push 32 bit return pointers (offset and segment) on the stack and the short versions use only 16 bit offsets. Functions are bounded with special statements which define the type of call to use to access the function and the type of return instruction to use. For example:

```
sample  proc    far
        CALL    sample   ; recursive call
        RET
sample  endp
```

The label *sample* is the address of the start of the function even though it appears at the end too. The words *far* or *near* indicate that calls to the function should use long and short values respectively. The CALL and RET instructions in this example would use 32 bit pointers.

1. DEFINITIONS

The first part of the program contains a set of constant definitions for offsets into the Request Header data structure and values for some fields. The following table of prefixes describes their usage.

Prefix	Usage
rh_	request header field offset
s_	rh_status field success value
e_	rh_status field error value
m_	rh_media field value
mc_	rh_check field value
a_	device driver header attribute field value

These offsets and values are used throughout the program. The offsets are defined with a leading constant plus the previous field offset. The constant is the size of the previous field in bytes.

Fields which are bit encoded may have multiple field values included as the value of the field. The device driver header attribute field is one example.

2. VARIABLES AND STRUCTURES

The variables and structure definitions come next in the source code. The very first item must be the first device header. There is only one in this example and the link field value is -1. Additional device headers would be linked via this field but the headers could appear anywhere within the program.

The next structure is the BIOS Parameter Block (BPB) table which is used for block devices only. There is one entry for each unit supported. The single entry is all that is required for this example. The offset refers to the BPB contained within the boot record image which comes next. This is used to initialize the memory drive and is retained because the BPB structure is used by the device driver.

The last variable is the address of the request header passed to the strategy routine. This is loaded by the interrupt routine for use by all support functions.

The last structure is the command dispatch table. It contains the offsets to the respective functions. The common part of the device interrupt routine uses this table to call the corresponding function based upon the command byte in the request header. Each entry in the table is a unique label even though the memory disk driver does not implement all functions. This

allows the table to be used for device drivers in general.

3. COMMON DRIVER SUPPORT CODE

The common device driver routines follow the constant and data definitions. The two driver entry points are included in this set of code. The device strategy routine (dev_strategy) is very short and simply stores the address of the request header where the interrupt routine can find it.

The device interrupt routine (dev_interrupt) saves, and later restores, the working register set on the stack. It sets up the data segment to match the code segment since many of the support functions operate best with this configuration. The request header address is then loaded and the command is used to index the command table. The corresponding entry is then used to call the appropriate function.

Each function returns the status code in the AX register whose value is placed into the status field of the request header before restoring the working register set.

All support functions simply return so they may be easily developed outside the device driver environment. The next section adds the device specific support code. All items up to this point can be used for any block device driver and, with minor changes, any character device driver.

4. MEMORY DRIVE SPECIFIC CODE

The device specific functions supported by the memory disk driver are:

Function	Description
initialize	setup memory disk
media_check	show non-removable disk
build_bpb	build BPB
read	read sectors
write	write sectors
write_verify	write and verify operation

Each of the supported functions will be addressed individually along with the two support functions source_address and destination_address. Non-supported functions all reference the function *unimplemented* near the end of the source listing.

The source_address and destination_address functions compute the segment and offset for the corresponding sector in the memory drive. They also compute the number of bytes to transfer based upon the number of sectors to transfer. The difference between the two is simply the segment and offset registers used. The source_address function uses registers DS:SI while the other uses ES:DI which corresponds to the 8086 string move register pairs. In essence the functions convert the parameters found in the request header block (sectors) into memory disk/8086 usable values (pointers and byte counts). The functions use the BPB values



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to perform their computation so the size of the memory disk can be changed by simply altering the BPB values.

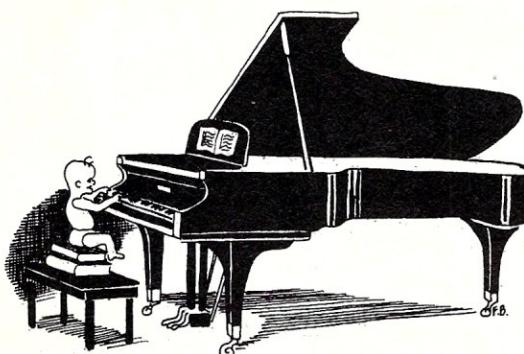
The initialize function is called once by DOS when the device driver is loaded. In theory, this code could be located after the end of the resident portion of the device driver because it is only used once. However, this is where the data for the memory disk is placed. Unfortunately, the first part of the memory disk contains data which is set up by the initialize function so it cannot overwrite itself. It is possible to move the code around but this increases the complexity of the system and would cause more confusion than it is worth. In fact, the code for this function is a very small percentage of the overall device driver size

since the resident portion of the memory disk driver includes the memory disk itself. It makes sense to put the initialization code at the end of the driver, if the memory disk itself were located on an extended memory board since the space could be returned to the system.

The first thing the initialize function does is compute the base segment of the memory disk. All sectors must be aligned to 8086 paragraph boundaries; this coincides nicely with the sector sizes that DOS uses, primarily 512 bytes. The base segment is saved in the device specific variable mdisk_segment. This is used by the source_address function to compute the proper segment for a given logical sector.

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The next operation performed by initialize is to copy the boot sector image to the first sector in the memory disk and then setup to the two File Allocation Tables (FATs). The FATs are identical and maintained by DOS. They are initialized so no files have been allocated. It is possible to set up pre-allocated files if required. These would also be referenced from the subsequent sectors which contain the directory. These are zeroed in this example, providing a completely empty disk with no allocated files.

The last thing the function does is to compute the address of the last byte used by the device driver. In this case it is the end of the memory disk which is well past the end of the program itself. This value is

computed by using the size of the disk in sectors which is found in the BPB. The value is placed in the proper request header field which DOS examines. The return value in the AX register indicates success.

Operations which the initialize function may perform in other block device drivers would include initializing a hard disk, determining a device's capabilities or current status, and setting the system to a known state. This would also be the place to set up interrupt vectors, stacks and interrupt routines.

The media_check function is very simple in this example because the device contains non-removable media, chips in this case. This is also true of most Winchester hard disks but would not be

true of floppy disks and removable disk cartridges. The value returned in the request header would depend upon whether the media had changed and what type of detection is provided to determine if the media had been removed. This may be tied into interrupt routines used by the driver (not the dev_interrupt routine).

The build_bpb function is used to generate the proper BPB for DOS. In this case, the operation is very simple because only one unit is supported and it cannot change. Also, the information is contained in the boot sector. Actually, the operation could be simpler by only using the resident BPB instead of reading the one from the boot sector. This operation was done to show how the function would be performed for more general block device drivers.

Dumb block device drivers would only have one BPB entry per unit because they only support one type of media. *Smart* block device drivers support various media types and usually determine the BPB based upon information from the device. This is typically a copy of the BPB in the boot sector. Although this is used for removable media devices, it can be used for non-removable media which would allow a common driver to be used for disks of different sizes or configurations.

The read, write and write_verify functions are very simple in a memory disk. They simply compute the memory address of the requested sectors and then transfer this data. The transfer is done using block move instructions at the byte level. This can be changed to moves at the word level since sector sizes are always a power of two. This would make a substantial difference if the processor is not an 8088 or 80188. This change could be implemented by simply dividing the number of bytes to transfer by two and replacing the byte transfer opcodes with word transfer opcodes. Also, the initialize function must be slightly altered to take into account the word count values being used.

The write_verify operation uses two tricks. First, the write function always saves the number of items transferred and leaves the registers pointing to the item just past the end of the buffer and the last sector in the memory disk. The 8086 string scan direction is reversed and the block compare instruction is used once the register have been adjusted accordingly.

MAKING CHANGES

The memory disk presented is set up for a reasonably sized drive which could be used for small programs, overlays or temporary files. It uses a small percentage of memory in a PC system with at least 512 Kbytes. However, the size is significant if used on a system with less memory.

The size of the disk can be changed by altering the values in the BPB. No changes are required in the rest of the code. In

general, the number of sectors must be changed along with the number of sectors used by each FAT. The FAT uses 1.5 bytes for each sector. Also each directory entry uses 32 bytes. The sixty four entry directory is normally enough for any processor memory disk drive.

SUMMARY

The memory disk device driver presents a basic block device which can be implemented on any system which runs DOS V2.x or later. It implements the basic block device functions but not the IOCTL operations. The memory disk can be easily changed by modifying the parameters in the BPB or modifying the support code with extended memory boards.

Replacing the memory disk specific code with tested code for a new disk drive would be required to develop a device driver for the new disk drive. These routines can be tested before being placed into a device driver for easier debugging. The major modification would be placing any initialization code after the end of the resident device driver code. This allows the space used by the initialization procedures to be returned to the operating system after the driver is initialized.

The next article will present a character device driver. It uses the same front end as the memory disk device driver. However, the rest of the device specific code is different. (H)

Bill Wong is the President of Logic Fusion, Inc., 1333 Moon Drive, Yardley, PA 19067, a systems software development firm.

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Source for MDISK.ASM

```

; === Loadable Memory Disk Device Driver ===
; by: William G. Wong
; Logic Fusion, Inc.
; 1333 Moon Drive
; Yardley, PA 19067
;

; =====
; V1.00 02-12-86 Initial version
;

; === Constant Definitions =====
; --- Request Header Structure Definitions ---
rh_length equ 0 ; (byte) length field
rh_unit equ 1 + rh_length ; (byte) unit field
rh_command equ 1 + rh_unit ; (byte) command code
rh_status equ 1 + rh_command ; (word) status field
rh_reserved equ 2 + rh_status ; (8 bytes)

rh_size equ 8 + rh_reserved ; request header size

; --- Request header status values ---
s_done equ 0100h ; done, no errors
s_busy equ 0200h ; busy, no errors

e_protect equ 8000h ; error: write protect
e_unknown_unit equ 8001h ; error: unknown unit
e_not_ready equ 8002h ; error: not ready
e_command equ 8003h ; error: unknown command
e_crc equ 8004h ; error: bad CRC
e_bad_length equ 8005h ; error: bad structure length
e_seek equ 8006h ; error: bad seek
e_media equ 8007h ; error: unknown media
e_not_found equ 8008h ; error: sector not found
e_paper equ 8009h ; error: out of paper
e_write equ 800ah ; error: write fault
e_read equ 800bh ; error: read fault
e_general equ 800ch ; error: general error not listed above

; --- Non-destructive read parameter block ---
rh_read_data equ rh_size ; (byte) non-destructive data

; --- Input/output parameter block ---
rh_media equ 0 + rh_size ; (byte) media descriptor
rh_buf_offset equ 1 + rh_media ; (word) transfer buffer offset
rh_buf_segment equ 2 + rh_buf_offset ; (word) transfer buffer segment
rh_buf_size equ 2 + rh_buf_segment ; (word) transfer buffer size
rh_start equ 2 + rh_buf_size ; (word) transfer starting sector

m_fixed equ 0f8h ; media: fixed disk
m_ss9 equ 0fcf ; media: single sided, 8 sectors/track
m_ds9 equ 0fdh
m_ss8 equ 0f6h
m_ds8 equ 0ffh

; --- Build BPB parameter block ---
rh_bpb equ 1 + rh_media ; preceeded by media descriptor
rh_tbl_offset equ 4 + rh_bpb ; (dword) bpb table offset/segment
rh_tbl_segment equ 2 + rh_tbl_offset

; --- Media Check parameter block ---
rh_check equ 1 + rh_media ; preceeded by media descriptor
; (byte) media check result

mc_changed equ -1 ; media has changed
mc_maybe equ 0 ; media may have changed
mc_same equ 1 ; media has not changed

; --- Initialize parameter block ---
rh_units equ 0 + rh_size ; (byte) number of units supported
rh_end_offset equ 1 + rh_units ; (word) end address of driver
rh_end_segment equ 2 + rh_end_offset ; (word) BPB array address
rh_bpb_offset equ 2 + rh_end_segment ; (word) BPB offset
rh_bpb_segment equ 2 + rh_bpb_offset

```

```

; --- Device Driver Header Attribute Definitions ---
a_input      equ  0001h      ; standard input device
a_output     equ  0002h      ; standard output device
a_nul        equ  0004h      ; NUL device
a_clock      equ  0008h      ; CLOCK$ device
a_dos        equ  0           ; DOS block device ( bit 13)
a_not_dos    equ  2000h      ; non-DOS block device ( bit 13)
a_ioctl      equ  4000h      ; IOCTL functions supported
a_block      equ  0           ; block device (bit 15)
a_character  equ  8000h      ; character device (bit 15)

; --- Device Driver Definition ====
cseg segment para public 'CODE'
driver proc far
assume cs:cseg,ds:cseg,es:cseg
dd  -1           ; last driver in chain
dw  a block + a dos
dw  dev_strategy ; offset to strategy routine
dw  dev_interrupt ; offset to interrupt routine
db  l_           ; number of devices or device name
db  7 dup ( ? ) ; filler for block device

; === Device Driver Tables ====
; --- BIOS Parameter Block Table and Entries ---
bpb_table    dw    bpb      ; one entry for each unit

; --- Boot record for initialization ---
boot_record  db    3 dup ( 0 ) ; non-bootable (no jump instruction)
boot_record  db    'DOS 2.1.' ; identification
boot_bpb_offset equ ( $ - bootrecord )

bpb:
bytes_in_sector dw  512      ; BIOS Parameter Block
                     ; bytes/sector
                     ; sectors/cluster
bpb_reserved    dw  1         ; reserved sectors
bpb_fats        dw  2         ; number of FAT's
bpb_root        dw  64        ; directory entries in root
bpb_total       dw  360       ; total number of sectors
bpb_media       db  m ss8    ; media type byte
bpb_fat_size    dw  2         ; sectors/FAT

bpb_size        equ ( $ - bpb )
                     ; sectors/track
                     ; number of heads
                     ; hidden sectors

boot_size       equ ( $ - boot_record )

; --- Request Header Address set by dev_strategy ---
rh_address    dd  1 dup ( ? ) ; request header base address
rh_offset      equ  rh_address
rh_segment    equ  rh_address + 2

```

```

; --- Request Header Command Dispatch Table ---
cmd_table    dw    initialize ; initialize driver
              dw    media_check ; media check
              dw    build_bpb ; build BPB
              dw    ioctl_read ; IOCTL read
              dw    read_      ; normal read
              dw    check_input ; non-destructive read/status
              dw    input_status ; input status
              dw    input_flush ; flush input buffers
              dw    write_     ; normal write
              dw    write_verify ; normal write with read verify
              dw    output_status ; output status
              dw    output_flush ; flush output buffers
              dw    ioctl_write ; IOCTL write

; --- Common Device Driver Routines ====
; --- Device Driver Strategy Routine ---
; es:bx = request header address
dev_strategy  proc  far
              mov   cs:rh_offset,bx
              mov   cs:rh_segment,es
              ret
dev_strategy  endp

; --- Device Driver Interrupt Routine ---
dev_interrupt proc  far
              push  ax           ; save registers used
              push  bx
              push  cx
              push  dx
              push  di
              push  si
              push  ds
              push  es
              cld
              push  cs           ; clear direction flag
              push  ds           ; setup small memory model
              pop   ds           ; ds := program segment
              les   bx,rh_address ; es:bx := request header index
              mov   si,es:rh_command[bx] ; si := request command (byte)
              and  si,0ffh -
              add   si,si         ; si := word table offset
              call  word_ptr cmd_table[si] ; ax := command result
              lds   bx,cs:rh_addFess ; ds:bx := request header index
              mov   rh_stats[bx],ax ; update request status
              pop   es           ; restore registers
              pop   ds
              pop   si
              pop   di
              pop   dx
              pop   cx
              pop   bx
              pop   ax
              ret
dev_interrupt endp

; **** END OF DEVICE INDEPENDENT PORTION OF DRIVER ***
; --- Memory Disk Working Variables ---
mdisk_segment dw  0          ; memory disk segment set by initialize

```

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```

; === Memory Disk Device Driver Code ===
; --- Driver support functions (near functions) ---
; es:bx = request header
; ds = cs
; All other registers are usable.
; ax := result status
; --- Initialize driver ---
initialize proc near ; initialize driver
    lea    ax,mdisk_data ; ax := end of driver
    mov    cl,4           ; cl := paragraph size log2
    shr    ax,cl          ; ax := paragraphs in driver
    mov    dx,cs          ; dx := driver segment
    add    ax,dx          ; ax := memory disk segment
    mov    mdisk_segment,ax; update for subsequent transfers
    lea    si,boot_record ; ds:si := boot sector for disk
    xor    di,di
    mov    es,ax           ; es:di := boot sector on disk
    mov    cx,boot_size   ; cx := size of boot sector data
    rep    movsb           ; initialize boot sector

    mov    ax,cs:bpb_reserved ; ax := first FAT sector
    mov    bx,cs:bpb_fat_size ; bx := number of sectors
    call   destination_address ; es:di := first FAT, cx := size
    push   di
    push   es

    mov    al,cs:bpb_media ; al := media byte
    mov    [di],al          ; update FAT media byte
    mov    word ptr l[di],0ffffh ; allocate initial sectors
    add    di,3
    sub    cx,3
    xor    al,al
    rep    stosb           ; adjust FAT index
    ; adjust FAT size
    ; al := 0
    ; clear rest of FAT

    mov    bx,cs:bpb_fat_size ; bx := sectors/FAT
    mov    ax,bx
    add    ax,cs:bpb_reserved ; ax := second FAT sector
    call   destination_address ; es:di := second FAT, cx := size
    pop    ds
    pop    si
    rep    movsb           ; ds:si := first FAT index
    ; copy first FAT to second FAT

    mov    ax,cs:bpb_root
    mov    cl,5           ; cl := size of entry log2 (32 bytes)
    shl    ax,cl          ; ax := directory size
    mov    cx,ax
    xor    al,al
    rep    stosb           ; zero directory

    mov    ax,cs:bpb_total ; ax := total number of sectors
    mov    bx,1           ; bx := filler to prevent overflow
    call   source_address ; ds:si := end of driver/disk
    mov    ax,ds
    lds    bx,cs:rh_address ; ds:bx := request header address
    mov    byte ptr rh_units[bx],1 ; return number of units
    mov    rh_end_offset[bx],si
    mov    rh_end_segment[bx],ax ; return ending address of driver
    word ptr rh_bp_offset[bx],offset_bp_table
    mov    rh_bp_segment[bx],cs ; return BPB Table address

    push   cs
    pop    ds
    mov    dx,offset_initok
    mov    ah,9
    int    21h

```

```

        mov    ax,s_done          ; ax := done, no errors
        ret

initok db 'MDISK initialized',10,13,'$'

initialize endp

; --- Media check ---
; Memory disk is non-removable media

media_check proc near ; media check
    mov    es:byte ptr rh_check[bx],mc_same
    mov    ax,s_done          ; ax := function done, no errors
    ret

media_check endp

; --- Build BPB ---
; Read boot sector and copy into BPB buffer.
; Adjust request header values.

build_bpdb proc near ; build BPB
    mov    ax,0           ; ax := sector to read
    mov    bx,1           ; bx := number of sectors
    push   cs
    call   source_address ; ds:si := address, cx := bytes to move
    pop    es
    add    si,boot_bp_offset ; ds:si := sector offset
    mov    di,offset_bpdb ; es:di := BPB buffer address
    mov    cx,bpdb_size   ; cx := BPB size in bytes
    rep    movsb           ; copy BPB from boot sector to buffer

    mov    al,cs:bpb_media ; al := media byte
    lds    bx,cs:rh_address ; ds:bx := request header address
    mov    byte ptr rh_media[bx],al
    mov    word ptr rh_tbl_offset[bx],offset_bpdb
    word ptr rh_tbl_segment[bx],cs
    mov    ax,s_done          ; ax := function done, no errors
    ret

build_bpdb endp

; --- Read from device ---
read proc near ; normal read
    push   es
    pop    ds
    push   rh_buf_offset[bx] ; save destination offset
    push   rh_buf_segment[bx] ; save destination segment
    mov    ax,rh_start[bx]   ; ax := first sector to read
    mov    bx,rh_buf_size[bx] ; bx := number of sectors
    call   source_address   ; ds:si := source sector, cx := size
    pop    es
    pop    di
    rep    movsb           ; es:di := buffer address
    mov    ax,s_done          ; copy sector to buffer
    ret

read endp

```

```

; --- Write to device ---

write proc near
  push es
  pop ds
  push rh buf offset[bx]
  push rh buf segment[bx]
  mov ax,rh_start[bx]
  mov bx,rh buf size[bx]
  call destination_address
  pop ds
  pop si
  push cx
  rep movesb
  pop cx
  mov ax,s done
  ret

write endp

; --- Write and verify ---

write_verify proc near
  call write
  std
  dec si
  dec di
  repe cmpsb
  jnz verify_error
  mov ax,s done
  ret

verify_error:
  mov ax,e_write
  ret

write_verify endp

; === Support Functions ===
; --- Unimplemented functions ---

unimplemented proc near
  mov ax,e_command
  ret

unimplemented endp

ioctl_read equ unimplemented ; IOCTL read
check_input equ unimplemented ; non-destructive read/status
input_status equ unimplemented ; input status
input_flush equ unimplemented ; flush input buffers
output_status equ unimplemented ; output status
output_flush equ unimplemented ; flush output buffers
ioctl_Write equ unimplemented ; IOCTL write

; --- Compute Memory Disk Sector Address ---

; ax == sector (base 0)
; bx == number of sectors to move
; cx == bytes to move
; ds:si == sector address

```

```

source_address proc near
  mov dx,cs:bytes_in_sector ; dx := bytes/sector
  mov cl,4 ; cl := paragraph size log2
  shr dx,cl ; ax := paragraphs/sector
  mul dx ; ax := sector paragraph offset
  add ax,cs:mdisk_segment ; ax := sector segment
  mov ds,ax ; ds := sector segment
  mov ax,cs:bytes_in_sector ; ax := bytes/sector
  mul bx ; ax := bytes to move
  mov cx,ax ; cx := bytes to move
  or cx,cx ; zero := full segment move
  jnz sector_done ; skip if valid size (non-zero)
  dec cx ; cx := maximum transfer size (0ffffh)
sector_done:
  xor si,si ; si := 0 (byte offset)
  ret

source_address endp

; --- Compute Memory Disk Sector Address for Destination ---

; ax == sector (base 0)
; bx == number of sectors to move
; cx == bytes to move
; es:di == sector address

destination_address proc near
  call source_address
  mov di,si
  push ds
  pop es ; es:di := sector address
  ret

destination_address endp

; === Memory Disk Data Area ===
; Align to paragraph boundary for easy computation of the sector address
if (( $ - driver ) mod 16)
  org ($ - driver ) + ( 16 - (( $ - driver ) mod 16 ) )
endif
mdisk_data equ $ ; memory disk starts here

; === End of Memory Disk Device Driver ===
driver endp
cseg ends
end

```

Magnum Digital PRO-180 & FD-100

by Steven D. Kapplin

For the past year the 8-bit world has been abuzz with excitement over Hitachi's announcement of its new 8-bit CPU, the HD64180. This new chip provides many new features, yet is completely compatible with Intel's Z-80 processor. It provides extended memory addressing (up to 512k), on board DMA channels and serial ports, a memory management unit (MMU), and several new instructions, including hardware 8-bit multiply. The new chip operates at 6 Mhz (a 9Mhz version is also available) and promises greater throughput than a Z-80 running at the same clock speed.

Byte magazine (September and October 1985), ran a two-part series, by Steve Ciarcia describing a single board computer project based on the HD64180, dubbed the SB-180. And Micro/Systems Journal (May/June 1986) carried a construction article on building a 64180 S-100 CPU card. Now Magnum Digital, Inc. of Stover, Missouri is marketing the PRO-100, an S-100 CPU card, using the HD64180, and the FD-100, a companion floppy disk controller.

THE PRO-180

The PRO-180 features the Hitachi HD64180 micro-processor running at 6 Mhz. The board includes sockets which can accommodate up to 64K of RAM or ROM memory. The sockets can be configured with up to 32K of ROM in one socket (Hitachi modules, 2716s, etc. can be used) and 32K of RAM in the second socket. Thus, the PRO-180 can be configured as a stand-alone dedicated processor complete with ROM and RAM. Our evaluation board was supplied with two Hitachi RAM modules providing 64K of static RAM. The RAM can be assigned to any 64K bank using a dip switch.

The PRO-180 has three serial ports and a bus-port for remote control of the CPU. Two serial ports operate at speeds up to 38.4K baud. The third port is a clocked serial port which can operate at speeds up to 300K baud for use with local area networks. The CPU has plenty of jumpered options making it easy to configure the board to the user's system.

THE FD-100 DISK CONTROLLER

The floppy disk controller is designed around the Western Digital 2793 chip. Four

An S-100 CPU System Using The Hitachi HD64180

drives can be connected in any combination of 5 1/4" and/or 8". The 2793 is capable of auto-density and side select, so mixing different drives presents no problem for this disk controller. The card has a socket provided for a ROM, and ours was supplied with Magnum Digital's monitor ROM. A dip switch is provided for setting the port boundary for the 2793, which requires 8 consecutive ports. Few support chips are required for the FD-100. The board is very sparsely populated.

GETTING THINGS UP AND RUNNING

Magnum Digital supplies standard CP/M and Echelon's Z-System as available operating systems. At the time we were reviewing the PRO-180 the Z-System was not available (it is now available.) The standard CP/M supplied included Magnum Digital's customized versions of SYSGEN and MOVCPM as well as two specialized programs, SETSYS and CTRL. SETSYS is used to alter the disk parameter blocks and enable the OS to read foreign disk formats. Magnum Digital currently supports IBM 3740 and System 34 disk formats as well as its own native formats for 8" and 5 1/4" disks. Magnum Digital's native formats include SSDD and DSDD 8" disks configured with 1,024 byte sectors, 9 sectors per track. This provides 675K and 1.35 meg of formatted storage for SSDD and DSDD, respectively. Magnum Digital also supports 48 and 96 tpi 5 1/4" drives in DSDD format, only.

CTRL is a program enabling one to read individual sectors from a disk of virtually any format. Sectors are read into memory where they can be dumped or written to another disk. This provides a rudimentary disk editing capability.

I installed the PRO-180 and FD-100 in an old IMSAI 12-slotted (no front panel). Magnum Digital supplied two CP/Ms, one

on 5 1/4" disk and one on 8". Both were double-sided double-density. Unfortunately, my 8" drives are single-sided, so I started out using the 5 1/4" disk. The system boots up in the ROM monitor first. The monitor provides two disk boot options: boot from a 5 1/4" in drive A or boot from an 8" in drive A. The 5 1/4" system booted up with a short sign-on message announcing that this was a 60K CP/M system. Magnum Digital's implementation of CP/M is fairly straight forward. The five inch system was configured with drives A and B as DSDD 5 1/4", 48 tpi. Drives C and D were configured as DSDD 8". Installation was relatively simple and I had no difficulty getting the system to boot and run.

The PRO-180 monitor is not extensive, but provides all the essential requirements of a monitor including commands to display, move, and alter memory. Disk boot from the monitor is provided, and CTRL permits reaccess to the monitor from the OS.

ADVANTAGES OF THE PRO-180/FD-100

After spending good money for this hardware, what can you expect in the way of performance? I benchmarked the PRO-180 against my 4 Mhz CCS Z-80 system. Using the Sieve and Dhampstone benchmarks, I found that the PRO-180 is exactly twice as fast as my Z-80 for processor-bound activities. Total throughput was tested using the Dhampstone benchmark which includes disk I/O operations. This benchmark ran 35 percent faster on the PRO-180. I tested other disk-bound operations as well. The PRO-180 loaded Wordstar 16 percent faster than my Z-80. Magnum's BIOS for the PRO-180 uses multiple sector reads and writes which provides for very quick disk routines. A scroll from the top to the bottom of a 32K text file took 15 seconds on a 5 1/4" disk using the PRO-180 and FD-100 controller. The same scroll required 31 seconds on my CCS Z-80 and controller.

There is little question that the PRO-180 and FD-100 provide a significant increase in system speed and throughput. The 6 Mhz HD64180 is twice as fast as a 4 Mhz Z-80 due to the faster clock speed and the fact that the HD64180 instructions are

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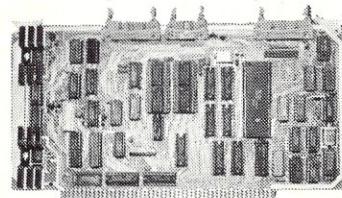
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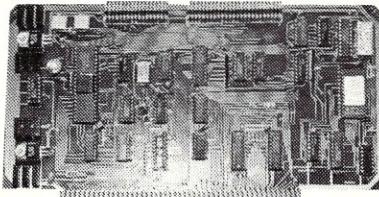
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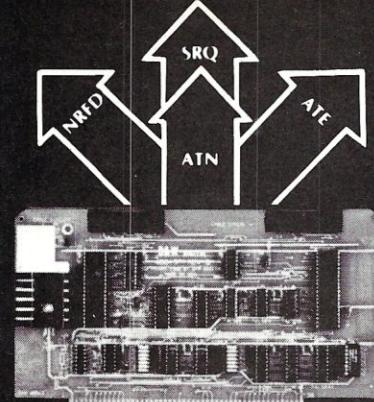
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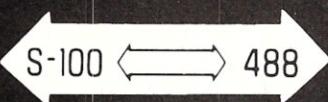
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mostly 3 clock cycles rather than the Z-80's 4 clock cycles.

PROBLEMS AND DISADVANTAGES

One of the major problems we discovered is that the PRO-180 will be difficult to get working with another disk controller. We were not able to get the PRO-180 to work by itself with either a CCS 2422 disk controller or with the Morrow Disk Jockey DMA controller. Magnum Digital informed us that a boot ROM would more than likely have to be prepared to permit the PRO-180 to work properly with other disk controllers. This means that installing a PRO-180 without the FD-100 would not be a trivial task. I believe that only experienced OEMs or systems houses would be able to provide a working system. If you buy both the PRO-180 and FD-100, however, installation should prove relatively simple. In its current configuration, however, the PRO-180 can only boot from the monitor. No provisions are made to permit a cold boot directly from disk, bypassing the monitor boot routines. This is a minor, but annoying inconvenience.

A second disadvantage is that the PRO-180 has no parallel port for driving a printer. Furthermore, Magnum Digital uses the HD64180's serial port 1 for the console. Port 1 has handshaking implemented, but Port 2 does not. Therefore, no hardware handshaking is available for the serial printer port (Port 2). It would have been a cleaner implementation to have the console on Port 2, as most terminals require no handshaking. Thus, Port 1 would provide hardware handshaking for serial printers. Under the current configuration you would have to implement handshaking in software for a serial printer. If you have a parallel printer, then you will need to get a serial interface for it! This is not a serious problem, but would represent an added cost to the conversion from a Z-80 system to the PRO-180.

A third problem exists for those of you with front panels. The PRO-180 does not support front panels. It does, however, provide a jumper to enable/disable MWRT for those whose front panels generate MWRT.

DOCUMENTATION

The PRO-180 comes with a thick manual, but most of it is the technical data taken from the Hitachi HD64180 technical manual. The actual board documentation is somewhat sparse. If you are not an experienced hacker or have friends who are, I would not tackle configuring the PRO-180 and FD-100. If you are attempting to install only the PRO-180, be sure you have expert help available. The manuals are definitely written with the OEM in mind. The casual user would find the manuals difficult to understand. A complete source listing of the monitor ROM is provided in

the documentation. There is a Table of Contents, but no index. The source for the monitor and BIOS are provided on disk to permit user customization.

The manual for the FD-100 is not as overtly attractive as that for the PRO-180, but I found it to be a few degrees more useful. Again, however, this manual is not intended for the novice.

Unfortunately, no documentation is provided for CP/M nor for the customized programs. SYSGEN, SETSYS, and CONTRL are all menu-driven, and thus easily used, but they have many features which require explanation. I understand that documentation will be available in the near future. The current documentation provides no assistance for system regeneration. This would be expected of a product aimed more for the OEM or system house market than toward the end-user.

FINAL OBSERVATIONS

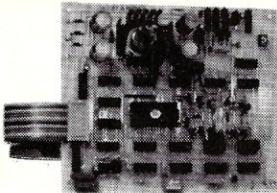
The PRO-180 and FD-100 make an excellent upgrade of a Z-80 or 8080 system. I was impressed by the speed increase. The PRO-180 will certainly be enhanced by the addition of Echelon's Z-System which will help take advantage of the new Hitachi chip. The PRO-180 should be purchased with the FD-100, unless you are looking forward to a long and difficult task of ROM burning and customization. In fact, I would not recommend the PRO-180 to the casual end-user. It is definitely better to have an OEM or system house configure a system for you, if you are not an experienced hardware user. Were it not for many friends in the area, I would have found installing the PRO-180 by itself an impossibility. The addition of the FD-100 controller made the installation easier, but not readily adaptable to my system.

The PRO-180 and FD-100 appear to be a reasonably good hardware buy, but needs more extensive and better documentation for less experienced users. The need for a special boot ROM will make use of the PRO-180 without the accompanying disk controller extremely difficult for anyone other than OEMs or system houses. Although not confirmed, there maybe some problem in adapting the PRO-180 to systems using the Morrow Disk Jockey controller. The PRO-180 provides the advantage of being able to move up to the HD64180 processor without scrapping one's S-100 hardware. The price is quite attractive: the two board set is currently being offered for \$569.00 complete with CP/M (and, now, probably Echelon's Z-System.) μ

Steve Kaplin is Associate Professor of Real Estate and Finance at the University of South Florida. He has been an active "hacker" since 1981. He can be reached via CompuServe ID 70055,1021 or through the Finance Department at the University.

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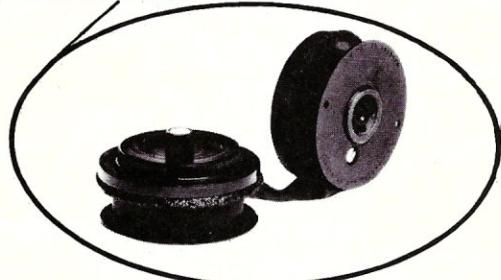
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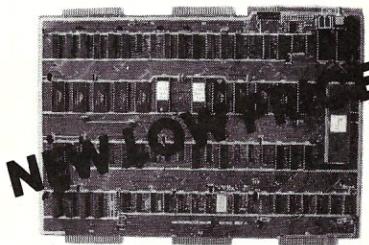
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Declare & Define C Variables In One File

by Bill Rogers

The statements for defining and declaring an external variable in C are different¹. Further, only the definition statement can include initialization. A combined definition and declaration scheme can lead to ease in maintenance and to increased program clarity.

By means of the C preprocessor, it is possible to make a single statement define, declare and initialize an external variable.

The storage-class specifier *extern* is used to declare an external variable. To define an external variable, no storage-class specifier is used.

The external variable is both defined (no storage-class specifier) and declared ("extern") with the pseudo-storage-class specifier "EXTERNAL". See FLAG_1 and FLAG_2 in the header file "flags.h" in

Figure 1. Further, if the defined variable is initialized, the initial value is conditionally compiled if "EXTRINIT" is currently defined. See FLAG_2 in the header file "flags.h" in Figure 1.

To define the external variables FLAG_1 and FLAG_2, use the sequence given in the c source file "definer.c" in Figure 2. "EXTERNAL" is replaced with nothing. Since "EXTRINIT" is defined, the initialization clause for FLAG_2 is included. The resulting C preprocessor output is given in Figure 4.

To declare the external variables FLAG_1 and FLAG_2, use the sequence given in the c source file "declarer.c" in Figure 3. "EXTERNAL" is replaced with "extern". Since "EXTRINIT" is not defined, the initialization clause for FLAG_2 is not included. The resulting C pre-

processor output is given in Figure 5.

The origin of this scheme is the section on BDS C program conversion in the Computer Innovations C User's Manual².

[μ]

¹ "A declaration announces the properties of a variable (its type, size, etc.); a definition also causes storage to be allocated." Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language. Prentice-Hall, Englewood Cliffs, NJ. 1978. pg 76.

² Computer Innovations, Inc., Optimizing C86 User's Manual. Document Version 2.3. May 1985. pg 1-32.

Bill Rogers is a programmer with Concentric Associates, Secaucus NJ.

```
/* flags.h */
EXTERNAL int FLAG 1;
EXTERNAL int FLAG 2;
#ifndef EXTRINIT
    = 0
#endif
;
```

Figure 1. Header File Defining/Declaring External Variables.

```
/* definer.c */
#define EXTERNAL
#define EXTRINIT
#include <flags.h>
#undef EXTRINIT
#undef EXTERNAL
```

Figure 2. Program File Defining External Variables.

```
/* declarer.c */
#define EXTERNAL extern
#include <flags.h>
#undef EXTERNAL
```

Figure 3. Program File Declaring External Variables.

```
definer.c 1:
definer.c 2:
flags.h 1:
flags.h 2:
flags.h 3: int FLAG 1;
flags.h 4: int FLAG 2
flags.h 6:
flags.h 7:
flags.h 8: ;
```

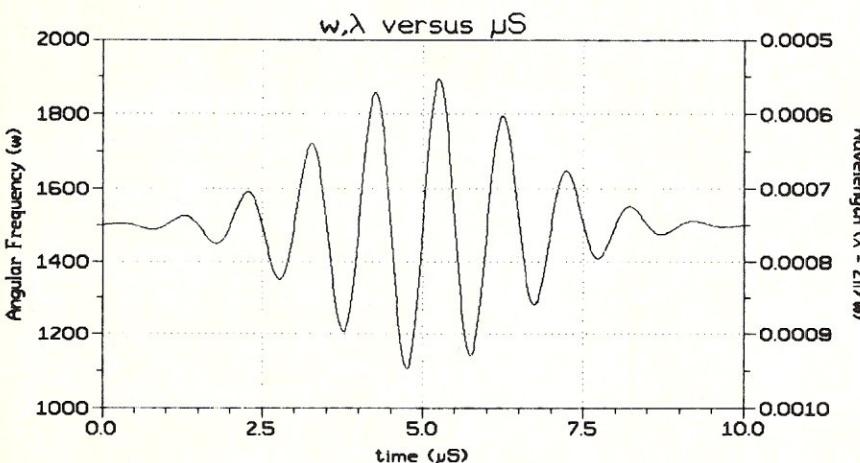
Figure 4. Preprocessor Output from "definer.c".

```
declarer.c 1:
declarer.c 2:
declarer.c 3:
flags.h 1:
flags.h 2:
flags.h 3:extern int FLAG 1;
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flags.h 7:
flags.h 8: ;
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Figure 5. Preprocessor Output from "declarer.c".

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The UNIX File

by Ian F. Darwin

This column discusses the UNIX operating system. If you have comments or questions about UNIX or this column, please write to Ian Darwin at Box 603, Station F, Toronto, Ontario, Canada M4Y 2L8. If you have access to the uucp network, mail "ihnp4!darwin!ian". I can't always answer immediately, but I will get back to you; electronic mail gets answered first!.

A friend asked me to check whether a title he was planning to use for a UNIX book had already been taken. I called into Dialog Information Services and looked into the Online edition of Books In Print (OBIP). I didn't find the title he wanted, but I did find no less than seventy-one books on or about UNIX. Included in the group are some books I've never heard of, catalogs of UNIX products, and some duplicate entries. Several books, that I know of, are not listed. My breakdown of the 71 is as follows: 45 textbooks, 8 reference cards, 7 books on word processing and typesetting, 7 product catalogs, and a few books on languages, applications, and other topics. Rather than try to review each of them (maybe I should write a book about all the other UNIX books!), I thought I'd describe one or two good or interesting books from each area.

INTRODUCTORY TEXTS

There are so many introductory texts now that it's hard to know what to say. The "best" by far is *Introducing the UNIX System* by McGilton and Morgan. Another good book is *A UNIX Primer* by Lomuto and Lomuto. *UNIX For People* by Brown et al. is a good non-technical introduction despite some factual errors. Mark Sobell's *A Practical Guide to the UNIX System* is a little more detailed; there's also a version of this book customised for System V. Good introductions for programmers or those who've used other computer systems include Kaare Christian's *The UNIX Operating System* and Steve Bourne's *The UNIX System*.

WORD PROCESSING & TYPESETTING

Morris Krieger's *Word Processing on the UNIX System* does a credible job of

A UNIX Book Roundup

explaining how to use *nroff/troff* and the editor. Krieger's presentation uses the *-ms* formatter macros. A shorter book on the same topic by Constance Brown, Jack L. Falk, and Richard D. Sperline is *Preparing Documents with UNIX* (Prentice-Hall, 1986, ISBN 0-13-699976-X). At about two hundred pages (and half the size of Krieger's book), this book also uses *-ms*, and it presents templates for letters, resumes, and other common documents rather than detailing the principles of *nroff/troff*. The book includes a glossary of text formatting and typesetting terms. Nahraim Gehani's *Document Formatting & Typesetting on the UNIX System* provides similar coverage using the *-mm* macros, at a level between the Brown and Krieger books, but also suffers from some problems in typesetting. Several other recent works cover editing, or editing and formatting, but I haven't seen copies of them yet.

PROGRAMMING TEXTS

The UNIX Programming Environment by Brian Kernighan and Rob Pike is highly recommended; it covers the gamut of topics on programming for UNIX. Marc Rochkind's *Advanced UNIX Programming* concentrates on UNIX system calls as used by the C programmer, with numerous examples including the source for a simple (non-programmable) UNIX shell.

I have just received a copy of *Introduction to Compiler Construction with UNIX* and haven't read it carefully yet; it includes coverage of *yacc* and *lex* as well as introducing compiler-writing techniques.

BOOKS ON UNIX OPERATING SYSTEMS

There is no widely-available text on how current versions of UNIX work. A commentary by John Lions described the Sixth Edition in some detail, but was only

available from AT&T; they have apparently stopped distributing it. Doug Comer's *Operating Systems: The XINU Approach* presents the design and source code for an educational tool; XINU is an OS that is in some ways like a subset of UNIX. The code is presented in the book, and is available from the publisher. Ric Holt's *Concurrent Euclid, the UNIX System and Tunis* gives some good descriptions of how major parts of UNIX work; Tunis is an experimental UNIX work-alike system written at the University of Toronto.

SYSTEM ADMINISTRATION?

I don't know of any good books on UNIX system administration. Online Books In Print lists *DOS UNIX: Becoming a Super User*; this sounds like it might be about system administration, but it could also be a book about IBM PC's. *UNIX System Security* by Wood and Kochan covers a range of topics on security, and looks useful despite a few factual errors about what features are in what version of UNIX.

UNIX CATALOGS

The grandest of the UNIX catalogs is the */usr/group UNIX Products Directory*. The 1986 edition is the size of a telephone book, although it's not printed in the same type style. There are two or three listings per page, each describing some hardware or software offering related to UNIX. It pretty much covers the whole market.

OTHERS

Finally a UNIX book in another language; Silvester's *Guide à la construction d'un système UNIX* (Springer-Verlag, 1985) is the first foreign-language book on UNIX listed in OBIP. But it appears to be a translation, possibly of Silvester's *The UNIX System Book*.

Most interesting title: *Tricks of the UNIX Masters* anonymous, Sams Publishers. Sounds like it could be "Secrets of the Jedi Masters", but I haven't seen a copy yet.

There are many books that I haven't mentioned; most are books that I haven't *continued on page 93*

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- A list may have any number of keywords, and any mix of categories.
- **Search output is a list of "hits"**, the id numbers of the abstracts which satisfy the query, stored to a file.

Resume Example

Categories are: T = title, F = function, G = year graduated, P = product area, \$ = salary, D = degree, M = major, S = school

Sample Abstract #43	Sample Queries
id keyword 43 T_Asst. Director 43 F_Sales 43 G_73 43 P_Fabrics 43 P_Yarns 43 P_Clothing 43 \$_37000 43 D_MBA 43 M_Marketing 43 S_Columbia U.	(a) experience in Sales and Marketing; not a V.P. or Director; 10-15 years work experience; current salary not higher than \$50K. ALL MATCH F_Sales MATCH F_Marketing NONMATCH T_Director T_V.P. GRTR/= G_71 LESS/= G_76 LESS/= \$_50000 ANY NONMATCH T_Director T_V.P. T_C.E.O. NONMATCH P_Steel

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Hochstrasser's Modula-2

by Edward J. Joyce

Modula-2, like most computer languages, traces its roots to the mainframe world. In 1979, Niklaus Wirth and a team of software engineers designed the first compiler on a DEC PDP-11 computer at the Swiss Federal Institute of Technology (Eidgenossische Technische Hochschule, or ETH) in Zurich. From there the language made its way down the computer totem pole, starting with the Lilith (a Modula-2 computer engine built by Wirth and Richard Ohren) and spreading to the IBM PC, Macintosh and Apple II. Meanwhile, no version surfaced for CP/M-80 and it seemed as if an inexplicable wall had arisen between Wirth's latest brainchild and one of the most popular operating systems.

That wall came down in July of 1985 when Peter Hochstrasser announced the first Modula-2 implementation for CP/M-80. Distributed by a company that bears his name, Hochstrasser's Modula-2 brings a state of the art language to the legions of loyal users who still compute in the eight-bit CP/M world.

Hochstrasser started on CP/M Modula-2 while at ETH in Switzerland. He and three others wrote the software as part of an academic thesis. During the course of the project, they consulted with the primary architects of the language, including the maestro of Modula-2 himself, Niklaus Wirth. Indeed, the acknowledgements section of the user's manual reads like a *Who's Who in Modula-2*.

The fact that Hochstrasser's product originated at ETH, where Wirth concocted both Pascal and Modula-2, lends authenticity to the package. The software is not a subset or stripped-down version. On the contrary, it even includes floating point arithmetic, assembly language interfaces, extensive library modules and other items one might not expect from an initial CP/M implementation.

Strictly speaking, the product should be called Modula-2 for Z80 CP/M, which is how the vendor refers to it. The compiler, linker and related programs execute only on a Z80 microprocessor and the code generated, which can be embedded in ROM, contains Z80 instructions. The

8080 and 8085 microprocessors, generally included under the umbrella of CP/M compatibility, are not supported.

The system generates Z80 machine code. In other words, the final output of the linker is an executable object file (or .COM file in CP/M parlance). The object file contains all run-time support routines needed. It does not rely on auxiliary files for input and output. For example, with the popular Sieve of Eratosthenes benchmark program, the compiler generates a 2K object file that is ready for execution.

The executable object file approach stands in contrast to pseudocode, also called P-code or M-code, produced by some Pascal and Modula-2 compilers. These systems typically compile programs faster, but they lose their advantage during execution because an interpreter must interpret the pseudocode. The machine code generated by Hochstrasser's four-pass compiler, on the other hand, is executed directly by the Z80 and the difference shows in superior performance.

Since Modula-2 is by design a simple language, much of its power stems from library modules supplied with the implementation. Hochstrasser provides the standard module library defined by Wirth, namely, elementary procedures for input and output from a terminal or file, math functions and storage management. This basic offering is then augmented by a robust library of utility modules.

MathLib0, the standard math library, goes by the title MathLib, without a suffix, in this system. Besides the eight math functions prescribed by Wirth, it contains a procedure for exponentiation. According to the user's manual, MathLib corresponds with the math library proposed by MODUS (Modula-2 Users Association).

One of the strongest assets of the utility library rests in a module called OpSys. OpSys opens the door to the nitty-gritty of the CP/M operating system. It gives the programmer direct access to CP/M's BDOS and BIOS. For example, selecting a disk or checking the keyboard for a character is only a procedure call away through OpSys.

Programmers writing business applications will be pleased with the library's string manipulation modules. These modules handle command line parsing, massaging of text data, and conversions between the internal format of real and integer numbers and their displayable ASCII forms. What programmer hasn't had to build one of these routines from scratch during his or her career?

The library's file management routines take the grunt-work out of retrieving and recording data on disk by providing sequential and random file access mechanisms. Although vanilla Modula-2 makes no provision for random access, Hochstrasser includes a module that closely resembles FileSystem. FileSystem is the file management module Wirth constructed for his Lilith computer. It supports file positioning at the byte and record level with error checking.

Another library component which further enhances the attractiveness of this system as a general purpose tool for software development lies in the chaining module. It allows one program to invoke or *chain* to another program. The module accommodates sharing of data between the chained programs, too. The chain facility is invaluable for multi-program applications such as a mailing list printing, where the first program selects mailing addresses according to specified criteria, a second program sorts the addresses, and a third program prints the addresses on mailing labels.

Although the developers of this system profess to be avowed proponents of Modula-2, they did not turn their backs on other programming languages. They recognize those situations where a programmer needs to incorporate software written in other dialects into a Modula-2 program. Hochstrasser's system offers an assembler interface for meshing Modula-2 with foreign tongues. The user's manual spells out the interface, describing register usage, parameter passing, machine level representation of data, and other details.

Hochstrasser's linker combines the assembler routines with Modula-2 code. The format of the relocatable code files

Modula-2 for Z80 CP/M

Manufacturer

Hochstrasser Computing AG
Chrätzstrasse 14
8954 Geroldswil
Switzerland

U.S. Distributors

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System Requirements

CP/M Operating System
Z80 microprocessor
56K RAM
Two disk drives

Price
\$165

processed by the linker bears a close resemblance to Microsoft relocatable (.REL) files. An appendix in the manual outlines the linker's format. For easy conversion of Microsoft .REL files to Hochstrasser's format, a utility program is delivered on the distribution disk.

Hochstrasser thoughtfully included Modula-2 source code for the library modules on the software's three distribution disks. Consequently, the curious programmer can trace the complete flow of logic when a call is issued to a library routine. Availability of source code is a refreshing change from other high level language products that hide input and output operations in *black box* interfaces or run-time packages which inevitably complicate debugging.

For example in Hochstrasser's Modula-2, reading a character from a sequential disk file through the procedure Read of standard module InOut generates the following events. The Read procedure invokes (or *imports* in Modula-2 terminology) Texts, a module which processes streams of text from a file or the console. Texts brings in a module called SeqIO for sequential input and output from files. Finally, SeqIO issues the appropriate calls to the operating system through CP/M's BDOS to retrieve the desired sector of data. This last step will be bypassed, if SeqIO already has the desired character in a buffer obtained from a previous read operation.

The layered approach allows the programmer to choose any of several levels

for handling input and output ranging from high-level, device independent access to low-level, step-the-disk-drive type dialogue.

Owners of budget CP/M systems, like me, whose disk domain consists of a mere dual set of single density floppy drives might shy away from a software package that spans 533K of space on three distribution disks. Although the software comes delivered that way, you can operate with less than three disks online. I was able to configure a working system on two disks by judiciously manipulating the library modules and deleting source code files, which are not required for compilation and linking.

Lately, some software entrepreneurs have the nerve to sell language compilers without cross reference generators under the guise of "professional programming tools." In my mind, a compiler without a cross reference is about as useful as a disk without a directory. Fortunately, Hochstrasser didn't take the shortcut of leaving out this essential element—a stand-alone program generates the cross reference in a disk file or directly on the printer.

Other software supplements include several source code examples which serve as introductions to CP/M Modula-2. There's the ubiquitous Sieve of Eratosthenes program and a solution to the eight Queens problem in chess. For recreational relief between intense periods of Modula-2 programming, Hochstrasser delivers a game program called Take, in which the user and computer alternately remove sticks from a pile in increments of one, two or three until the loser is left with the last stick (the program plays a mean game).

The qualities inherent in the software, comprehensiveness and correctness, carry over to the user's manual, too. The 250-page typeset document thoroughly explains the compiler, linker, library modules and other system components. Pascal keyboard-jockeys will especially value the language introduction which spells out the differences between Modula-2 and Pascal.

Overall, Hochstrasser has done a commendable job of introducing Modula-2 to the CP/M-80 arena. Programmers dealing with both applications and systems software will find a well-rounded tool in this package. The \$165 price covers royalty fees, which accounts for one more reason why Hochstrasser's Modula-2 warrants serious attention among CP/M software jocks. 

Ed Joyce, author of Modula-2: A Seafarer's Manual and Shipyard Guide (Addison-Wesley, Reading, Mass., 1985), is an ardent fan of Swiss cheese, Swiss chocolate, Swiss army knives and Swiss computer languages.

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More Loadable BIOS Drivers For CP/M

by Ted Carnevale

Cal Sondgeroth's article on loadable drivers for CP/M 2.2, (Micro/Systems Journal vol.1 #2 pp.66-71, 1985) was a real eye-opener for me. His XBIOS and XLOAD programs showed a convenient, straightforward way to intercept calls to the BIOS.

It would be useful to have utilities that would tell what BIOS extension modules had been loaded, and allow removal of extensions as necessary without rebooting the system. Furthermore, since some installations of CP/M have additional entries in the BIOS jump table, it would be nice if the BIOS extension loader XLOAD could install modules independently of such nonstandard enhancements.

One way to do this is to add a header to the BIOS extension module. This header would contain data needed by XLOAD and other utilities that manipulate BIOS extension modules, and could be checked by utilities that need to know if a BIOS extension was installed. I revised XLOAD and XBIOS accordingly, and wrote two other programs in C that would describe installed BIOS extensions and allow me to remove them.

Intercepting BIOS Calls

Details of Sondgeroth's approach are best obtained from his article (especially Fig.2), but a short description is appropriate here. The BIOS extension module XBIOS contains a special warm boot routine and two jump tables: one that is a copy of the prior contents of the BIOS's own jump table, and another that contains jump instructions to whatever BIOS service routines the user prefers. It is this second table that is the key to the utility of the BIOS extension module.

XLOAD moves XBIOS into place at the top of the TPA, copies the original BIOS's jump table into the proper location in the XBIOS module, and modifies the original table so that the BIOS jumps to the XBIOS. It also changes locations 6 and 7 to point to the start of the XBIOS module, thereby reducing the TPA and protecting the XBIOS from being overwritten. One of the nice features of XLOAD is that it shows how the bit map at the end of an

An Enhancement To Tell The Loaded BIOS Extension & Add & Remove Extensions Without Reboot

.SPR file can be used to relocate code. If necessary, this could be modified to accommodate .PRL files instead.

Several BIOS extension modules can be loaded, one after another. The jump tables in the demonstration listing of Sondgeroth's article are constructed so that jumps to BIOS routines (except for warm and cold boot) will pass through all of the BIOS extension modules, finally reaching the BIOS itself. Obviously, a practical BIOS extension module will contain one or more jumps to its own service routines.

The programs that I wrote carry the examples of XLOAD and XBIOS a step further. I wanted to be able to identify what modules had been loaded, and in what order. Also I wanted to be able to remove them one at a time.

To make this easier, I rearranged XBIOS and put a header at its beginning that contains certain useful items (see NUXB in Listing 1). The header is exactly 32 bytes long. After the module is loaded, its first three bytes will be "jmp bdos," the same as in the original version of XBIOS.

The fourth and fifth bytes allow the design of generalized utilities to handle BIOS extension modules. The fourth byte

is used by the BIOS extension loader (LXB—Listing 2) and other utilities to find where the jump tables begin. Its value equals the total length of the *version* and *function* strings (see below), which must be 255 or fewer bytes.

The fifth byte in the header specifies how many jump instructions are to be copied from the BIOS into the BIOS extension. This is handy for use with *enhanced* BIOS's that have jump tables with additional functions.

Bytes 6-16 are presently unused. Bytes 17-32 contain the string "xBIOS installed\$" which serves two purposes. When a BIOS extension has been installed, this message is shown on the console at every warm boot. It is also checked by utilities in order to verify that a BIOS extension is in place.

Immediately after the fixed length header comes a data area that contains *version* and *function* strings that tell the date and revision number of the BIOS extension, and what it does. These strings are terminated by nulls so that they can be readily manipulated by C programs.

The copy of the previous contents of the BIOS jump table comes next (OLDTBL), followed by the BIOS extension's own jump table. There didn't seem to be any reason to preserve the cold boot jump in this revision of the BIOS extension module.

The XLOAD program has been changed to LXB (Listing 2), which accommodates the revised structure of the BIOS extension module. The major change was to include code to find the OLDTBL area of the BIOS extension. Like XLOAD, LXB will load and relocate a BIOS extension module from a file with an .SPR extension. SPR files can be produced from REL files with Digital Research's LINK by using the "OS" option switch.

NUXB and LXB were not designed to intercept BDOS calls. A flexible way to do this might be to use the first two reserved bytes in the BIOS extension header as storage for the BDOS entry address, while the first three bytes in the header would be a jump to a BDOS intercept routine in the extension module itself. If BDOS calls are

to be simply passed on to the BDOS, the intercept routine could consist of the instructions LHLD RESERV ! PCHL. Otherwise, the value in register C would be tested and the appropriate action taken. If this approach to BDOS intercepts is used, the loader would have to be revised to patch the BDOS address into the appropriate location in the header.

Two utilities that are useful for dealing with these BIOS extension modules are CXB.C and RXB.C. CXB (Listing 3)

shows the starting address and the version and function strings of all BIOS extensions that have been installed, starting with the one lowest in memory (i.e. the one most recently loaded). RXB (Listing 4) removes the most recently installed BIOS extension module, leaving the rest in place. These were written for the Software Toolworks C80 compiler, but should run with little or no change with any other compiler.

Loadable BIOS extensions bring additional flexibility to CP/M 2.2. The revised BIOS extension module, and loader, and the utilities CXB and RXB, make it easier than ever to modify CP/M's input/output facilities *on the run*. μ

LISTING 1 - NUXB.ASM

TITLE 'Loadable bios module for CP/M v.2.2'
PAGE 62

;After C.Sondgeroth's XBIOS—see M/SJ vol.1 #2 p.66 et seq.
;7/12/85 Modified to allow use of general xbios loader,
;and enable use of special utility to remove xbios's--NTC
;
;Compile with RMAC, then link like so:
;
; link nuxb[os]
;
;to produce .SPR file for use by bios extension loader LXB

CR EQU 0DH
LF EQU 0AH
CDISK EQU 4 ;addr holds currently logged drive
PRINTF EQU 9 ;bdos "print string" function

;These macros code for strings to identify bios extension.
;To allow easy manipulation by C programs, each macro
;should end with a null.
;NOTE: total length of data produced by these two macros
;must be 225 bytes or less.

VERSION MACRO
 ; revision number & date
 ; terminate this macro with a null
 DB 'v.1.1 7/12/85'
 DB 0
 ENDM

FUNCT MACRO
 ; tell what it's for
 ; put in lines as desired, with cr lf as needed
 ; restrictions:
 ;--terminate this macro with a null
 ;--total length of data produced by version & funct
 ; macros must be 255 bytes or less
 DB 'Tests new version'
 DB 0
 ENDM

;This header identifies xbios module & provides vital info
;used by loader and other utilities

;"continuation jump" to bdos--patched to correct location
;by xbios loader. If this is the only xbios module, this
;jmp goes directly to the original bdos. Otherwise, it
;goes to the xbios module that was previously loaded.
BDOS: JMP \$-\$

;distance from end of this header to the local copy
;of the original bios's entry table, i.e. total length
;of the version and function strings.
DB OLDTBL-HDREND

;distance from end of this header to the local copy
;of the original bios's entry table, i.e. total length
;of the version and function strings.
DB OLDTBL-HDREND

;how many jump instructions copied from the bios's table
DB (TBLEND - OLDTBL)/3

;Next 11 bytes reserved for future use
RESERV: DB 0
 DW 0,0,0,0,0

;Next string, which is exactly 16 bytes long and starts
;exactly 16 bytes from the first location in the xbios, is
;checked by utilities that manipulate resident xbios modules.
LABEL: DB 'xbios installed'\$

HDREND EQU \$

;end of fixed-length header

;strings that tell what it is & what it does
VERSION
FUNCT
;When bios extension is first installed, contents of
;original bios jump table are copied into following table.
;These jumps allow calls to any bios routines that are not
;supposed to be intercepted.
;If your bios has additional jumps that you might want to
;intercept, add more entries to this table

OLDTBL EQU \$
WBOOT JMP \$-\$
CONST JMP \$-\$
CONIN JMP \$-\$
CONOUT JMP \$-\$
LIST JMP \$-\$
PUNCH JMP \$-\$
READER JMP \$-\$
HOME JMP \$-\$
SELDISK JMP \$-\$
SETTRK JMP \$-\$
SETSEC JMP \$-\$
SETDMA JMP \$-\$
READ JMP \$-\$
WRITE JMP \$-\$
LISTS JMP \$-\$
SECTRAN JMP \$-\$

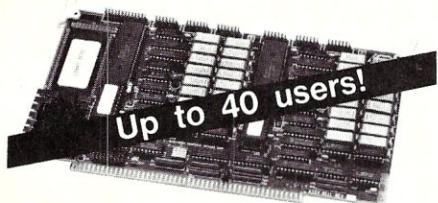
TBLEND EQU \$
;This table should be same length as OLDTBL.
;It defines new entry points for bios routines that are to
;be modified. Any routines that are not to be intercepted
;should jump to corresponding entries in previous table.
;Eventually they will reach original bios entry points.

NEWIBL EQU \$
JMP XWBOOT ;to special bios extension "warm boot"
;routine. This is only jump that cannot go
;to corresponding entry in previous table.
;rest of these may be modified to intercept bios call
JMP CONST
JMP CONIN
JMP CONOUT
JMP LIST
JMP PUNCH
JMP READER
JMP HOME
JMP SELDISK
JMP SETTRK
JMP SETSEC
JMP SETDMA
JMP READ
JMP WRITE
JMP LISTS
JMP SECTRAN

;Special warm boot routine that intercepts CP/M's attempt
;to overwrite call to bios extension's own jump table. It
;bypasses reload of CCP and reinitialization of low memory
;jump vectors that are part of a normal CP/M 2.2 warm boot.
XWBOOT: LXI SP,80H
 LXI B,80H
 CALL SETDMA
 LXI H,BDOS
 SHLD 6
 ;fix "jmp bdos" at 0005 to point
 ;to this module.
 ;send cr lf to console
 ;say xbios is running
 ;get bios+3 address
 ;calculate entry point of CCP
LXI D,CRLF
MVI C,PRINTF
CALL BDOS
LXI D,LABEL
MVI C,PRINTF
CALL BDOS
LHLD 1
LXI D,-1600H
DAD D
LDA CDISK
MOV C,A
PCHL
 ;jump into CCP
CRLF: DB CR,LF,'\$'
END

Ted Carnevale, an assistant professor of neurology at SUNY Stony Brook NY, is involved in research on information processing in neurons.

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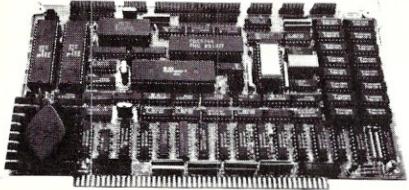
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LISTING 2 - LXB.ASM

TITLE 'LXB--BIOS extension loader'
PAGE 62

;After C.Sönderoth's XLOAD--see M/SJ vol.1 #2 p.66 et seq.
;Modified 7/12/85 by NTC for new xbios called nuxb

```

TRUE EQU 0FFH
FALSE EQU NOT TRUE
INTRUP EQU FALSE ;TRUE if hardware uses interrupts routinely
HDRLNTH EQU 20H ;# of bytes in xbios's constant-length header
BOOT EQU 0 ;warm boot entry
BDOS EQU 5
FCB EQU 5CH ;default fcb
CONOUT EQU 2 ;console output func
OPEN EQU 15 ;bdos open file
READ EQU 20 ; read sequential
SETDMA EQU 26 ; set dma addr
CR EQU 0DH
LF EQU 0AH

ORG 100H

XLOAD EQU $  
LXI H,0  
DAD SP  
SHLD STACK ;saves stack pointer  
LXI SP,STACK ;& creates local stack  
LDA FCB+1  
CPI ' ' ;check for name of bios extension (xbios) file  
JNZ XL20  
CALL MSG  
DB 'USAGE: lxb filnam',CR,LF  
DB ' where filnam is a bios extension file',CR,LF  
DB ' (.SPR extension assumed)'  
DB 0

CPM$EXIT:  
LHLD STACK ;restore stack pointer  
SPHL ;& bail out  
RET ;here starts file type  
XL20: LXI H,FCB+9 ;force .SPR extension  
MVI M,'S'  
INX H  
MVI M,'P'  
INX H  
MVI M,'R'  
INX H  
MVI C,24  
MVI M,0 ;# of bytes remaining in fcb  
INX H ;clear the rest of the fcb to nulls
DCR C  
JNZ SLCLR  
LXI D,FCB  
MVI C,OPEN  
CALL BDOS ;open the xbios file  
ANA A  
JP SL50 ;if successful  
CALL MSG ;else say failed  
DB 'unable to find the bios extension file'  
DB 0  
JMP CPM$EXIT

;Read the bios extension file into low memory
SL50: LXI H,BUF ;hl = dma addr  
SL60: PUSH H ;de = dma addr  
XCHG  
MVI C,SETDMA  
CALL BDOS ;tell cpm where to put next sector  
LXI D,FCB  
MVI C,READ  
CALL BDOS ;read next sector  
POP H  
LXI D,128  
DAD D ;hl = next dma addr  
ANA A  
JZ SL60 ;not finished  
;Relocate .SPR file's contents to high memory (just below  
;ccp, or below last xbios module)  
IF INTRUP  
DI  
ENDIF  
LDA BOOT+2 ;calc page of ccp  
SUI 16H  
MOV H,A ;hl = ccp base page addr  
LDA BDOS+2 ;current bdos page addr  
CMP H  
JNC REL1  
LHLD BDOS+1  
RELL: MVI L,0 ;else get current top of tpa  
XCHG  
LXI H,BUF+1 ;start on a page boundary  
MOV C,M ;de = 1+ top of tpa  
INX H  
MOV B,M ;hl points to length of spr code  
PUSH B  
INR C ;bc = length of spr code  
DCR C ;round bc up to an integral # of pages  
;if c = 0, code ends on a page boundary

```

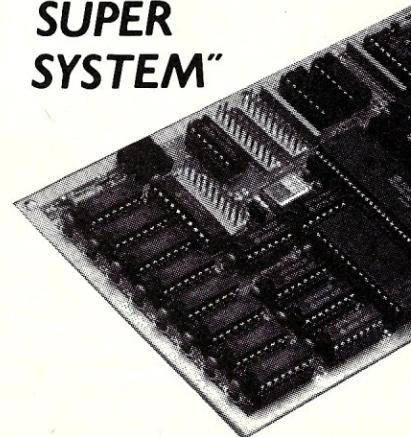
```

JZ REL2
INR B
MOV A,D ;calc where to move the code, put result in de
SUB B ;a = bios page
STA XBPAGE ;for future use
MOV D,A
MVI E,0 ;de = 1 + top of current tpa - code length
LXI H,BUF+256 ;start of relocatable code
POP B
PUSH B ;bc = actual length of spr code
PUSH D ;de = where to move it to (start of xbios)
CALL MOVEM ;first move it up without relocation
POP D ;de = start of xbios
LXI H,BUF+256 ;hl = start of relocatable code
POP B ;bc = length "
DAD B ;hl = start of bit map
PUSH D ;save page offset
XCHG ;hl = addr of code, de = addr of bit map
PUSH B ;save byte count
;Get the next bit map byte and use it to direct
;relocation of 8 bytes
;Stop when end of relocatable code is found
RELNMAP:
    MVI C,8
    LDAX D
    MOV B,A ;b = map byte
    INX D ;point to next map byte
;Shift & test relocation bits.
;If bit=0, don't alter code, else add offset for new base addr
RELNBYT:
    DCR C ;count bits in the byte
    JM RELNMAP
    MOV A,B
    RAL
    MOV B,A
    JNC NOREL
    LDA XBPAGE
    ADD M ;offset
    MOV M,A ;add offset to code
    NOREL: INX H ;next location to consider
    XTHL
    DCX H
    MOV A,H
    ORA L ;done?
    XTHL ;hl = code pointer again
    JNZ RELNBYT ;no, keep working
;After done with relocation:
;1. fetch the original bios jump table and save a copy of it
;   in the new xbios module
;2. modify the original bios jump table so it points to the
;   corresponding locations in the xbios's jump table
    POP B ;remove counter from the stack
    POP H ;hl = start of new bios module
    PUSH H
;Next section is for new xbios—NTC
;Copy original bios jmp table into xbios at OLDTBL
    INX H
    INX H
    INX H
;m = length of strings between end of header & start of jmp table
    PUSH H ;save place in the xbios header
    MOV A,M
    ADI HDRLNTH ;a = distance from start of xbios to
    MOV L,A ;start of jmp table
    XCHG ;hl points to start of strings
    ;de is addr of xbios's copy of orig jmp
    ;table (dest)
    POP H ;return to xbios preface for more
    INX H
    MOV A,M ;# of jmp instr in table (omits jmp cold)
    STA JMPNUM ;for future use
    ADD M
    ADD M ;a=length of jmp table in bytes
    ;(omitting jmp cold)
    MOV C,A
    MVI B,0 ;bc = # of bytes to copy
    LHLD BOOT+1 ;hl=addr of 1st jmp to copy from bios table
    CALL MOVEM ;copy orig bios jmp table > oldtbl in xbios
    LHLD BOOT+1 ;hl = addr of jmp wboot in orig bios table
    LDA JMPNUM
    MOV C,A ;# of jmp instr to patch
;Now ready to patch original jmp table to point to xbios's own
;table.
NEWJMP: INX H ;patch old jmp table to point to
    MOV M,E ;corresponding entries in xbios
    INX H
    MOV M,D
    INX H
    INX D
    INX D ;point to next entry addr in xbios jmp table
    DCR C
    JNZ NEWJMP ;to finish fixing the old jmp table
    POP D
    PUSH D ;de = addr of xbios
    LHLD BDOS+1 ;hl=destination-old bdos jmp (bdos entry)
    PUSH H ;saved on stack
    LXI H,BDOS+1 ;hl = where to patch jmp to xbios

```

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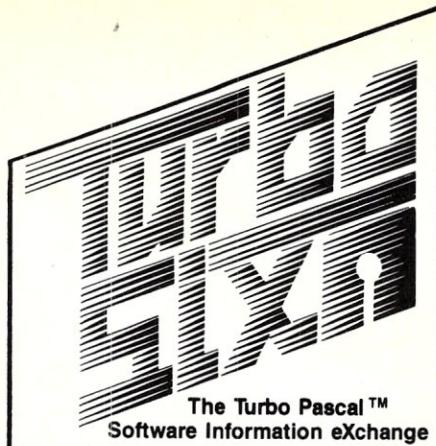
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```

MOV M,E
INX H
MOV M,D      ;now location 5 contains "jmp xbios"
POP B
POP H
INX H
MOV M,C
INX H
MOV M,B      ;now first jmp in xbios is "jmp bdos"
INTRUP
EI
ENDIF
RST 0          ;cp/m warm boot
;Send inline message, terminated by null, to console
;hl must point to the message
MSG EQU $
POP H
MOV A,M      ;a = next char
INX H
PUSH H
ANA A
RZ
MOV E,A
MVI C,CONOUT
CALL BDOS
JMP MSG
MOVEM: MOV A,M      ;move bc bytes from hl to de
STAX D
INX H
INX D
DCX B
MOV A,B
ORA C
JNZ MOVEM
RET
JMPNUM: DS 1      ;will hold # of jmps in bios jmp table
XBPAGE: DS 1      ;will hold page addr of xbios
DS 64
STACK: DS 2
BUF EQU $        ;spr file goes here first
END

```

LISTING 3 - CXB.C

```

/* cxb.c—checks for xbios modules
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*/
#include "printf.h"
#define VERSION "v.1.2 7/16/85\n\n"
#define TRUE 1
#define FALSE 0
#define boolean int
/* handy constants */
#define SIG "xbios installed$"
#define SIGLNTH 16 /* how many characters in signature string */

/* useful structures */
struct xhdr { /* replica of xbios module header */
    char jump, /* 0xc3 */
    *oldbdos, /* entry to bdos */
    *tboffset, /* how far from ystart to start of local
                copy of old jump table */
    jmpnum, /* how many jumps in table */
    reserved[11], /* unused at present */
    signature[SIGLNTH], /* signature string */
    vstart; /* 1st char of version string */
};

struct cpmbdr { /* replica of first few bytes in cpm */
    char jump1, /* 0xc3 */
    *wboot, /* address of jmp wboot in bios table */
    whatnot, /* user etc */
    drive, /* logged drive */
    jump2, /* another 0xc3 */
    *bdosloc; /* entry to bdos */
};

char *idstring=SIG;
boolean found=FALSE;

main()
{
    struct xhdr *xbintro;
    struct cpmbdr *cpmintro;
    char *vers,*descr;
    boolean xbexists;

    printf(VERSION);
    xbexists=TRUE; /* assume there is one */
    /* find start of suspected module */
    cpmintro=0;
}

```

```

xbintro=(struct xbhdr *)cpminstro->bdosloc;
while (xbexists) {
    /* now see if signature is where it should be */
    if (compare(idstring,xbintro->signature,SIGLNTH)) {
        found=TRUE;
        printf("xbios present at %x\n", (int)xbintro);
        vers = &xbintro->vstart;
        descr = &vers[strlen(vers)+1];
        printf("%s\n%s\n", vers, descr);
        /* try for the next one */
        xbintro=(struct xbhdr *)xbintro->olddbos;
    }
    else xbexists=FALSE;
}
if (!found) printf("no xbios installed\n");

boolean compare(sl,s2,num)
/* compare num bytes pointed to by sl and s2
   return TRUE if identical, otherwise return FALSE */
char sl[],s2[];
int num;
{
    int i;
    boolean equal;

    for (i=0,equal=TRUE; (i<num) && equal; i++)
        equal = sl[i]==s2[i];
    return (equal);
}

```

LISTING 4 - RXB.C

```

/* rxb.c—removes most recently loaded xbios module
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*/
#include "printf.h"
#define VERSION "v.1.2 7/16/85\n\n"
#define TRUE 1
#define FALSE 0
#define boolean int

/* handy constants */
#define SIG "xbios installed$"
#define SIGLNTH 16 /* how many characters in signature string */

/* useful structures */
struct xbhdr { /* replica of xbios module header */
    char jump, /* 0xc3 */
    *oldbos, /* entry to bdos */
    otbloffset, /* how far from vstart to
                  start of local copy of
                  old jump table */
    jmpnum, /* how many jumps in table */
    reserved[11], /* unused at present */
    signature[SIGLNTH], /* signature string */
    vstart; /* 1st char of version string */
};

struct cpmhdr { /* replica of first few bytes in cpm */
    char jumpl, /* 0xc3 */
    *wboot, /* address of jmp wboot in bios table */
    whatnot, /* user etc */
    drive, /* logged drive */
    jump2, /* another 0xc3 */
    *bdosloc; /* entry to bdos */
} *cpminstro=0; /* make it point where it should */

char *idstring=SIG;

main()
{
    struct xbhdr *xbintro;
    char *vers,*descr;
    printf(VERSION);
    /* find start of suspected module */
    cpminstro=0;
    xbintro=(struct xbhdr *)cpminstro->bdosloc;
    /* now see if the signature is where it should be */
    if (compare(idstring,xbintro->signature,SIGLNTH)) {
        printf("removing xbios from %x\n", (int)xbintro);
        vers = &xbintro->vstart;
        descr = &vers[strlen(vers)+1];
        printf("%s\n%s\n", vers, descr);
        interrupt(FALSE); /* disable interrupts */
        remove(xbintro);
        interrupt(TRUE); /* reinstate interrupts */
    }
    else printf("no xbios to remove\n");
}

```

continued on page 85

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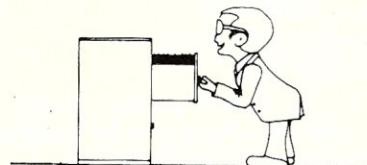
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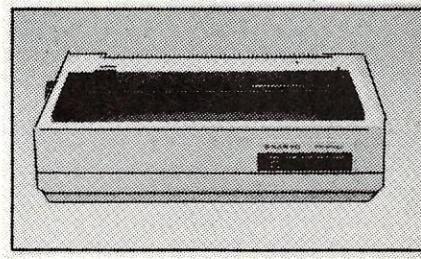
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PMATE

My favorite editor, PMATE, distributed by Phoenix Software Associates (at \$225), has come out in Version 4. I have been using one form or another of PMATE for the last ten years. Every time that I have looked at any other editor written for PCDOS, I have felt crippled because of the lack of power of that editor. To me the test of a good editor is the ability to perform extremely complex manipulations of the text using macros.

An ancestor of PMATE was TECO, a powerful command-oriented editor for use with dumb teletype terminals on minicomputers. Data General had a variation of it for NOVA minicomputers. In the early 1970's, Jonathan Sachs, working for a medical physics project at M. I. T., enhanced this editor, adding considerably to its power and giving it screen display capabilities. He later became the principal author of Lotus 1-2-3.

Sachs' editor migrated to Harvard, where it was further enhanced. Among the enhancers was physicist Paul Horowitz, now well known for having the world's most technically advanced SETI project (search for extraterrestrial intelligence). Paul had a graduate student, Mike Aronson, who took this editor, reorganized and further enhanced it, and rewrote it in assembly language for the 8080 microprocessor. Early versions were named MATE (Mike Aronson's Text Editor), but when Phoenix became the distributor of this CP/M version, they added the "P" in front of the name. Meanwhile, I had become intimately familiar with the Sachs editor, adding about 50 per cent to its length to support the VT100 terminal.

The very first piece of CP/M software that I obtained was PMATE. I disassembled the whole thing, mapped out the command dispatch tables, and made some changes. Meanwhile, the IBM PC entered the scene, and Mike Aronson produced CP/M-86 and MS/PCDOS versions of PMATE. He did it by writing a macro to translate 8080 assembly language into 8086/8088 assembly language. That is an excellent example of the PMATE capabilities. It also meant that when I got an MSDOS machine, I was able to disassemble that version of PMATE and write down the relevant paths through it by inspection, using the CP/M disassembly. In this way I could transport my modifications. I did this with a succession of PMATE versions through version 4.0.

PMATE, Fortran, Plotting, Calculating, *T_EX*

Enter Murray Sargent III, in the Optical Sciences Department at the University of Arizona, and his small company, Scroll Systems. He devised a text formatter, the Scroller, to format mathematics properly for daisy wheel printers. In the late 1970's he produced small printed circuit boards which inserted into Diablo printers; these intercepted an incoming stream of text and format characters and output the necessary printer control sequences to print the page properly. You could use any text editor, but Murray was a fan of PMATE. Later, for the Victor 9000 and the IBM PC, he did it all in software, merging PMATE with Scroller to form the PS technical word processor. This was the highest quality technical word processor available until *T_EX* came along. Murray wrote some 9 kilobytes of permanent macros (macro language is extremely compact) to make PMATE a menu-driven editor. The most recent version of PS that I have uses PMATE version 3.37.

PMATE version 4.0 is actually four separate programs, one of which is a limited multitasking environment in which you can run PMATE and another program at the same time. The other three versions of PMATE have different large permanent macro packages, one for word processing, one for Fortran development, and one for C development.

The word processing version is really version 3.37 with most of the PS menus intact (all but the menus for printing) and with some enhancements. The programming development packages take the errors output by the most popular Fortran and C compilers (Microsoft, Ryan-McFarland or IBM Professional Fortran and Lattice C) and place them at the appropriate lines of the source files; they also allow you to move around easily between and within modules of the source file. I do very little C programming have not used that version of PMATE, and since I now do Fortran development with Watfor-77, I have used the Fortran version of PMATE only a little. Many programmers will appreciate these

specialized versions of the editor.

Version 4 of PMATE comes with a configuration file so that you can customize it to your liking, particularly the keyboard locations of the instant commands. There is no configuration file for version 3.37, so it can only be customized with DEBUG, but the appropriate information is not given to allow you to do this. I have done it using my carry-over knowledge of PMATE internals. If you want a copy of my documentation for this customization, send a PCDOS-formatted floppy in a stamped mailer.

For a couple of years Aronson has been rewriting PMATE in C, at the same time modernizing the program so that it will take advantage of all available memory for the text buffer and incorporating multiple display windows. Many of us wait impatiently for this "CMATE". Clearly version 4 is meant only as an interim upgrade.

FORTRAN

About one and one-half years ago benchmarks by Avram Tetewski at Draper Labs showed IBM Professional Fortran to give faster run-time results than Microsoft Fortran. The IBM package had been developed by Ryan-McFarland, who also marketed the package under their own name. These versions are not identical, since IBM fine-tuned the program to their liking and produced much more extensive documentation. However, the programs give nearly identical benchmarks and can be considered together.

Ryan-McFarland has brought out a major revision in version 2.0. I assume IBM will issue their version of it later. The new version clears up a lot of minor irritants. My own irritant was the lack of a facility for opening a file for appending, but the new version allows this. Such a facility is particularly important when you want to run a program for days on end; if something happens so that the computer hangs or crashes, and you have an open file, then goodbye to all the results. It is a much better technique to open the file for appending when you want to write to it, and then to close it after you have written.

I have made only some very rough measures of performance, but I find that the new Ryan-McFarland version 2.0 runs about 20 to 40 per cent faster than IBM Professional version 1.0. Thus it is now my preferred Fortran for long production runs of a problem. It is typically available for \$399 from discount dealers.

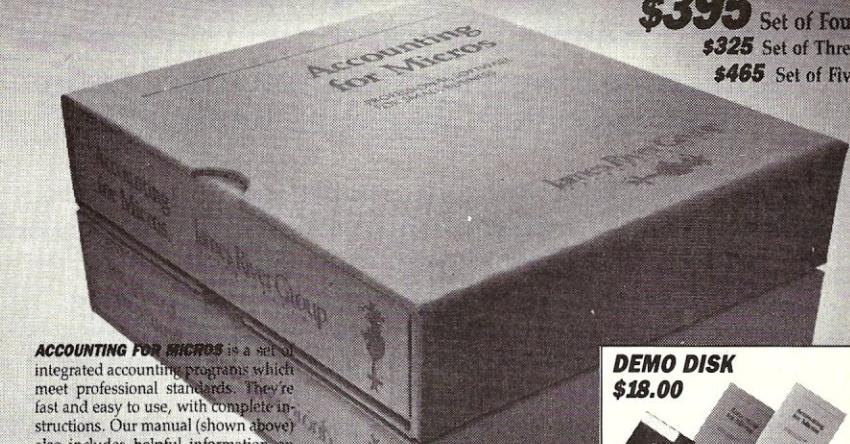
Meanwhile, an important new Fortran product has appeared, Watfor-77 from WATCOM Systems. This is nearly ideal for developing new Fortran code. For many years WATCOM Systems has been in the business of developing language compilers to be used by students learning the language, and they have now brought their expertise with Fortran to PCs.

Watfor does not operate in the usual edit-compile-link-run-edit-etc. cycle. Instead, the program compiles directly into the computer memory and then starts to execute. WATCOM initially supplied me with version 1.2 of the program; later they sent me a beta copy of version 1.4. Version 1.2 required that everything except standard Fortran functions be available as source code, and no EXE file was produced. Version 1.4 is a big improvement in that you can now pull in OBJ files that have been compiled with IBM Professional Fortran as well as routines in libraries intended to work with that compiler, and optionally you can produce EXE files. Watfor also may be run in residence mode; from within the program in interactive mode you can execute any DOS program, including your favorite editor. WATCOM supplies an editor, but it is an old-fashioned one which is line-oriented. Probably the biggest improvement that WATCOM could make at this point would be to develop a good character-oriented editor which is an integral part of the compiler.

On receiving this program I checked it out on some code that I had just spent three weeks developing and for which I was confident that I had found all the bugs. Watfor immediately informed me that there were four variables that had not been initialized. Sure enough, there were four places where I had spelled variables with a 0 (zero) instead of an O—something that I could stare at forever and not notice on the screen. This endeared the program to me right away. There are many checks in the program that are not contained in ordinary Fortran compilers. There are also many extensions beyond standard Fortran, particularly in the realm of controlling the flow of program logic. You should be cautious in using these, however, if you want to transport your source code to other compilers. As a compensation, Watfor gives a warning message when you use these extensions. Watfor has a debugger that lets you set breakpoints at Fortran statements and lets you step through the program by Fortran statements. When the program is halted you can examine the current values of all the variables and change some if you wish.

My rough benchmarks indicate that Watfor compiles into memory in 0.1 to 0.2 of the compile + link time of IBM Professional Fortran. The smaller number applies to cases where the IBM compiler can do a lot of optimization; the larger

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number applies where little optimization is possible. This is one of the reasons why I prefer to use Watfor for development. On the other hand, a program run under Watfor will execute a factor of 2 to 4 slower than one compiled with IBM Fortran; the latter number applies when a lot of optimization has been possible. My current advice is to develop under Watfor and do long runs with Ryan-McFarland Fortran; the two programs work together nicely.

Watfor-77 costs \$295 for an indefinite licence. It is also available on one-year leases with a site license for businesses and educational institutions. The latter version of the code checks that your date is within the allowed range. The section of code that does this is checksummed

and encrypted and the license declares that it is illegal to run with an incorrect date in your machine.

Excellent news for Fortran and Pascal users is the publication of *Numerical Recipes. The Art of Scientific Computing*, by W. H. Press, B. P. Flannery, S. A. Teukolsky, and W. T. Vetterling (Cambridge University Press, xx + 818 pp., \$39.50, produced using TeX). The authors state, in their introduction, "this book is unique, we think, in offering, for each topic considered, a certain amount of general discussion, a certain amount of analytical mathematics, a certain amount of discussion of algorithmics, and (most important) actual implementations of these ideas in the forms of working computer rou-

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tines." The goal of the book is to include everything up to, and even a bit about, partial differential equations. Surprising as it may seem, the discussion includes a touch of wit now and then. This approach is far superior to the standard collections of scientific subroutines, of which several are now available for PCs, since it provides a good guide to when you should use one technique and when another.

Commented Fortran source code is provided throughout. The Pascal equivalents are collected toward the end of the book. The Fortran and Pascal source code, without comments, is available on separate diskettes for PCs (\$19.95 each). There are also example diskettes (\$19.95), and somewhat overpriced *Example Books*

(\$18.95) in softcover for each language.

PLOTTING

Fortran libraries of plotting subroutines have for the most part concentrated on screen displays and output to pen plotters. I have found this frustrating because dot matrix printers such as the FX-80 and its compatibles have the sufficient resolution to produce publishable graphs. But until recently none of the software products have taken advantage of this resolution. Now such a product has appeared; it is SciPlot, from MicroGlyp Systems (\$59.95). I have been very interested in following the progress of this product over the last few months as it has been contin-

ually enhanced by its author, C. L. Vote, in part due to my prodding. It started out as a CP/M product.

SciPlot has the usual commands that one finds in scientific plotting packages, although they are not quite compatible with CalComp routines used on mainframes, so that if you want to transport a program a little rewriting will be necessary. Like the better plotting packages, it makes use of subsets of the Hershey vector character set, and you can use proportional spacing. Mr. Vote has also included several interpolation routines for manipulating data; if these are not good enough for your application you could use others in *Numerical Recipes*. A supplemental package gives source code for the subsets of Hershey characters and Fortran tools to manipulate them. This allows you to change characters or design new ones. Since the Hershey character set is in the public domain, you could also make up sets of missing Hershey characters, although you would have to get the vector listings separately.

SciPlot plots on CRT displays and on a few hard copy devices. Initially a color display was required, but the Hercules monochrome graphics card is now supported. Dot matrix printers are the IBM Graphics/Proprietary and the Epson FX185/FX-80/MX-80/etc. In addition, the Apple LaserWriter can be used as a high-resolution graphics device; Mr. Vote has just begun to probe the potentialities of this device, since he just uses the vector plotting capabilities and does not use the internal character sets (however, this is one way to use the Hershey characters with this laser printer). The LaserWriter output looks very nice; I would recommend that line widths be scaled to character sizes when Mr. Vote makes his next revision. The dot matrix plots are adequate for publication in most professional journals.

MATRIX CALCULATOR

Matrix Calculator from SoftTech Inc. (\$59.95) is a general purpose interactive math package. It is available in a plain stand-alone version, an 8087 version, and a memory-resident version called RESIDENT. Most of the operations are intended to be done on matrices, which can be quite large in size. However, the simplest matrix is a single number, and I found that doing ordinary arithmetic and finding standard functions of numbers with this program was intuitive.

In addition to the matrix operations, which include solutions to sets of linear equations, a variety of numerical integration, statistical, and other functions such as gamma functions are available. The package is very powerful. The input and output can be stored as disk files, so there will be many cases in which people will prefer to work with data interactively rather than

to design Fortran programs to do so. The manual has a very large number of spelling errors, but I find that these detract rather little from the comprehension of the procedures. Very definitely worth while.

TeX NEWS

See my previous columns for extensive discussions of TeX. Here is an update. Both MicroTeX (Addison-Wesley, now \$295 without a printer driver) and PC TeX (Personal TeX, now \$249 without a printer driver) have released version 1.5 of TeX. The main advantage of this for microcomputers is that the memory allocation procedures are revised to be more efficient, so that some unusual conditions which might have overloaded memory in previous versions of TeX will now be handled properly. Personal TeX is also distributing a program to convert the dot matrix pixel font files to a more compact form, which takes up only about 35 percent of the space. This will be a big boon to hard disk users.

Version 2.0 of TeX will differ from 1.5 only in the sign-on message, but with version 2.0 will come the "final" set of TeX fonts, which are called "Computer Modern", in place of the existing distributions of "Almost Modern" fonts. Thus I suspect that there will be a delay of many months before MicroTeX and PC TeX are issued in version 2.0 with all these new fonts. This change

Addresses

Addison-Wesley Publishing Company, Reading MA 01867. (617) 944-3700.
American Mathematical Society, P.O. Box 1571, Annex Station, Providence, RI 02901-1571. (800) 556-7774.

Cambridge University Press, 510 North Ave., New Rochelle, NY 10801. (914) 235-0300 in NY and Canada, (800) 431-1580 elsewhere.

MicroGlyp Systems, P.O. Box 1066, East Arlington MA 02174.

Personal TeX, Inc., 20 Sunnyside, Suite H, Mill Valley CA 94941. (415) 388-8853.

Phoenix Software Associates, 1416 Providence Highway, Suite 220, Norwood MA 02062. (800) 344-7200.

Ryan-McFarland Corporation, 609 Deep Valley Drive, Rolling Hills Estates, CA 90274. (213) 541-4828.

Scroll Systems, Inc., 6930 East Acoma Place, Tucson, AZ 85715. (602) 885-1633.

SoftTech, Inc., 18505 W. 8 Mile Rd., Detroit, MI 48219. (313) 544-8544

WATCOM Systems Inc., 415 Philip Street, Waterloo, Ontario, Canada N2L 3X2. (519) 886-3700.

look forward to the time when this program will be available on PCs; three of his related books describing it are to be published by Addison-Wesley this summer. These are *The METAFONTbook*, *METAFONT: The Program*, and *Computer Modern Typefaces*.

Large TeX macro packages have now become available. These include the final version of LATEX, a major package which relieves users of the necessity of giving a lot of "set-up" commands to TeX; the manual, *LATEX*, by Leslie Lamport, is available from Addison Wesley (\$18.95). Also now available is *AMS-Tex*, which incorporates styles appropriate to preparing articles for publication in journals of the American Mathematical Society. The manual, *The Joy of TeX*, by M. D. Spivak, is available from the Society (\$34).

TeX is now available for the Macintosh. MACTEX is actually version 2.0 of TeX, and so it will have the Computer Modern fonts distributed with it. It was developed by David Kellerman and Barry Smith in Portland, Oregon, and will be marketed by Addison-Wesley (\$495). This program will have the capability of including MacPaint and MacDraw pictures in TeX documents. □

A. G. W. Cameron is Professor of Astronomy at the Harvard-Smithsonian Center for Astrophysics, 60 Garden Street, Cambridge, MA 02138.

marks the coming to maturity of Donald Knuth's **METAFONT** program, which is used to design characters in new fonts. I

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Software Review

XPIP

by Edward J. Joyce

Extended Utilities For MS-DOS & CP/M

MS-DOS and CP/M resemble houses without furniture. They satisfy a basic need, like empty houses provide shelter, with few concessions for comfort and convenience. Consequently, most computing users invest in accessory software designed to improve one's lot while living within the domains of these operating systems.

One of the best bargains in accessory software for the MS-DOS and CP/M environment is a extended utility called XPIP. This \$29.95 program fills many of the gaps found in the bare bones operating systems. The developers of XPIP call it an integrated system utility. Functionally, it serves as a super file handler that performs basic file maintenance plus dozens of additional tasks.

XPIP operates in two modes: as a one-line command with options or from a menu of nearly twenty-five selections. If a question arises regarding a selection in the menu mode, a single keystroke produces help information. The help file spans 50K on disk, which gives a clue as to the thoroughness of the context-specific information.

The command selection covers standard operations such as file renaming, copying and deleting. The advantage of using XPIP for file deleting instead of MS-DOS's ERASE or CP/M's ERA command lies with XPIP's options. Each command selection is coupled with about ten options depending on the nature of the command. For example in deleting, you may first sort the file directory by name, type (or extension) or size, mark the files to be deleted individually, or specify

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groups of files to be deleted through *wildcard* selectors in the file specifications.

The MS-DOS version supports additional options for file selection criteria. You can select files according to their creation times such as before or after a given date.

Other options pertain to output. The displayed output may be printed with a selectable number of lines per page. Similar control exists over the screen. An initial screen definition step configures the software for any terminal. During execution of XPIP, the speed of scrolled displays may be increased or decreased by pressing designated keys.

XPIP shows its strength as a super tool in the areas of searching, editing and maintaining directories. String searches may be conducted within a file or across an entire disk. XPIP displays each occurrence of the requested text along with the file name and line number within the file.

The editor alone is worth the price of the entire package. It operates on 128-byte sectors within a file. Any sector may be accessed by sequential scanning or by entering the record number. The sector contents are displayed in both ASCII and hexadecimal form. Characters can then be modified and the sector subsequently updated on disk.

Maintaining MS-DOS directories becomes a snap under XPIP. The program makes and removes directories and shows directory tree structures. A shortcut for moving files between directories may rank as the program's greatest timesaver. Instead of physically copying a file from one directory to the other and erasing the original, XPIP simply adjusts the directory indexes. The adjustment entails a fraction of the time required to make a physical copy and the user needn't worry about allowing for sufficient space to temporarily accommodate the copy.

XPIP embodies numerous other commands including file comparison and math calculations (in binary, octal or hexadecimal). If you had the time, you could probably piece together some of its functionality from public domain software. But you would be hard pressed to find all of its commands within one package accompanied by a sixty-page user's manual. At \$29.95, this is one software accessory that can't be beat. 

Ed Joyce is author of *Modula-2: A Seafarer's Manual and Shipyard Guide*, Addison-Wesley, Reading MA 1985.

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continued from page 77

```
boolean compare(s1,s2,num)
/* compare num bytes pointed to by s1 and s2
   return TRUE if identical, otherwise return FALSE */
char s1[],s2[];
int num;
{
    int i;
    boolean equal;
    for (i=0, equal=TRUE; (i<num) && equal; i++)
        equal = s1[i]==s2[i];
    return (equal);
}

interrupt(choice)
/* if choice TRUE, enables interrupts
   else disables them */
boolean choice;
{
    /* not implemented in this version,
       since my bios doesn't use interrupts.
       --use inline code if needed */
}

remove(xbmod)
struct xbhdr *xbmod;
{
    int i;
    struct jumpinstr {
        char jump;           /* the 0xc3 itself */
        *dest;               /* the target address */
    } *xbjmptbl,*biosjmptbl;
    /* pick up start of next xbmod module
       from one about to be removed */
    printf("new bdos entry will be %x\n", (int)xbmod->olddbos);
    cpmintro->bdosloc=(char *)xbmod->olddbos; /* fix jmp
       bdos at 5 */
    /* next copy "old jump table" from module into bios */
    xbjmptbl= (struct jumpinstr *)(&xbmod->vstart +
        (0x00FF & xbmod->otbloffset)); /* mask out hi
       bits of offset */
    biosjmptbl=(struct jumpinstr *) (cpmintr->wboot);
    for (i=0; i<xbmod->jmpnum; i++)
        (biosjmptbl++)->dest=(xbjmptbl++)->dest;
}
```

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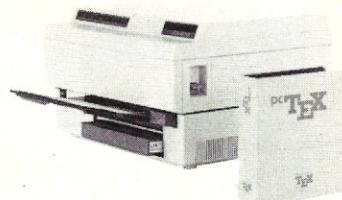
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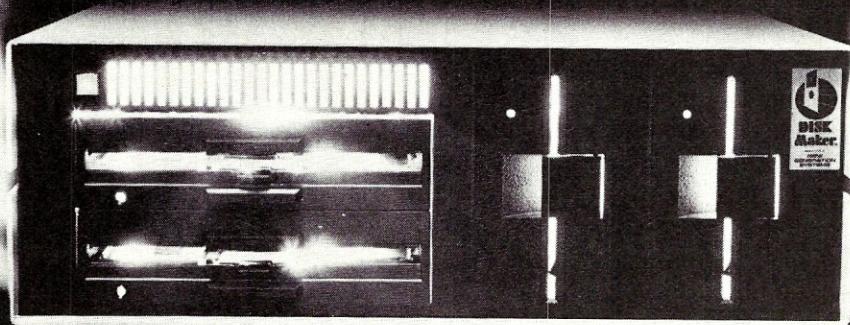
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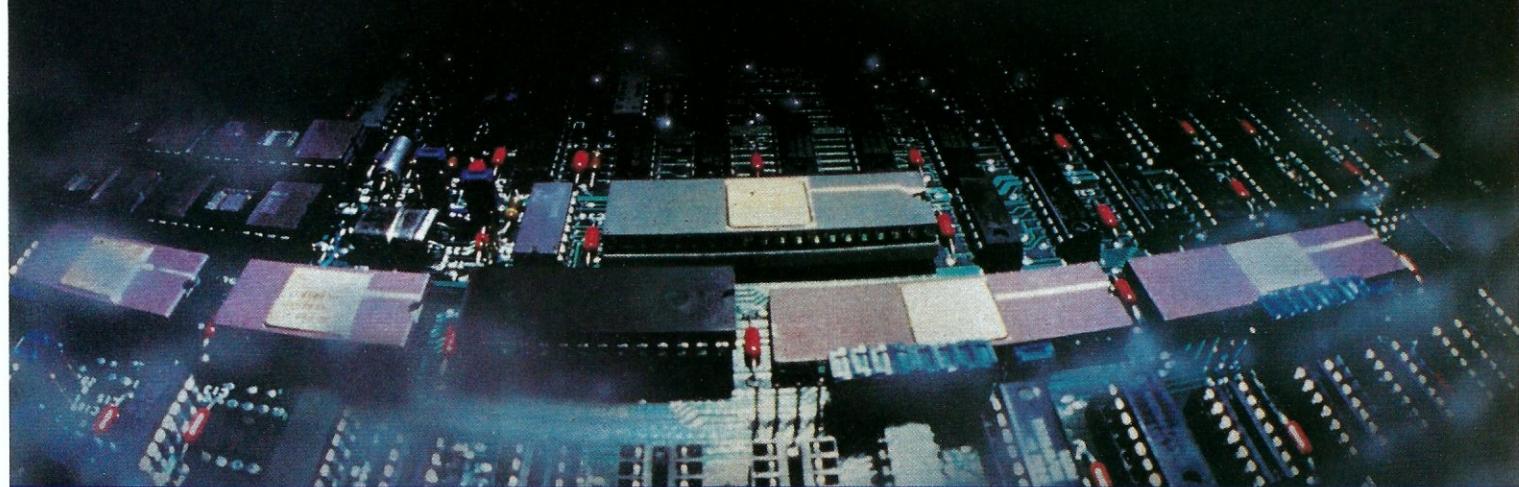
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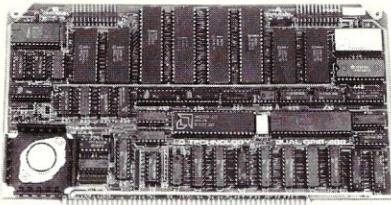
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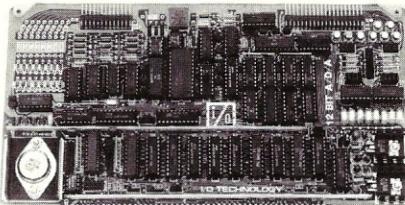
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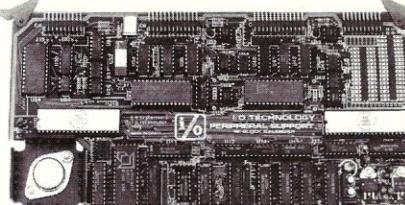


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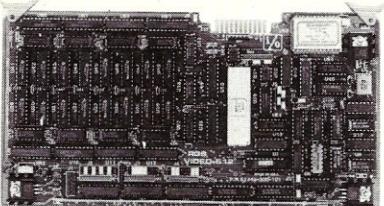
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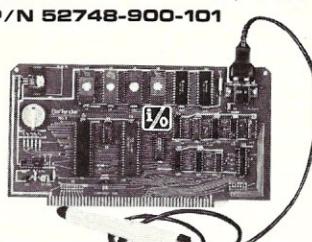
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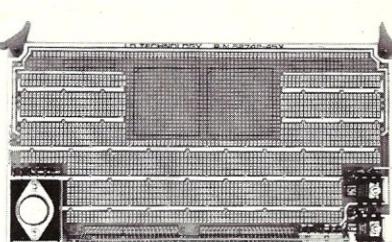
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The Data Base Forum

by Nelson T. Dinerstein

Reflex was developed by Analytica who failed at marketing the product and sold it to Borland. Borland cut the price to a fraction of the original and in the first two weeks over 15,000 copies were sold.

Reflex provides many of the features that you would expect to find in a simple database management system. It also provides some rather nice data analysis tools. Note that these tools are not the standard statistical tools, although some of the basic statistical functions are provided.

You can, as expected, define a database file structure, enter data, modify, delete data, and produce reports. Each user application is limited to one database file; it is not possible to link files together. Since you are limited to one file, the best you can do (in most cases) is to design a file that is in the first normal form. In particular, the typical file will contain information about two or more real world objects. For example, consider a file that contains sales information. To store a complete record, the file needs to contain information about each of the following: the salesperson, the item sold, the purchaser, and the specific sale information, i.e., the date of the sale, the quantity purchased, etc. This can cause two problems: large amounts of data are duplicated (potentially using too much space), and the data can be difficult to maintain. Reflex allows you to designate a field as REPEATING TEXT, if you find that there is a considerable amount of duplication. It appears that REPEATING TEXT reduces the amount of disk space required to store such a file, but true factoring has not been implemented. As a result, if you wish to change a value in a Reflex database file, you must manually change it in all places where it occurs. Since Reflex does not contain a programming language, the user must enter all the keystrokes necessary to perform the desired operations. Because of the problems with the maintenance of the data and because of the lack of a programming language, Reflex is probably not suitable for the development of professional quality information systems. Nevertheless, I believe Reflex has its place in the scheme of things.

Some of the features I like about Reflex are:

1. Reflex is relatively easy to use, since all of the functions are invoked through the use of pop-up menus. Even if you don't know how to use Reflex, you can work your way through a typical application by just examining the menus

A System Builder's Review Of Reflex

until you find the function that you want.

2. The functions you need to enter, store, manipulate, and report data have been included. In addition, a powerful yet easy to use tool to select records has been integrated with a number of functions. You can specify the selection criteria and then use it either to visit the individual records one at a time or you can use it to filter out records that either do or do not satisfy the selection criteria. After the records have been filtered out, they are easily restored with a single keystroke.
3. The report writer is unusually easy to use, powerful and flexible.
4. Working data can be displayed on the screen simultaneously in up to three different formats or views: as a list, a form, or a graph. The list view presents the data in tabular format, the form view presents the data one record at a time as a document, and the graph view presents the data in graphical form. You can move from one window (view) to another, add new windows (up to three), delete windows, and change the size of individual windows. You can even fill the screen with one of the windows and then shrink it back down again when you are through with it.
5. A reasonably powerful set of functions is included. You can mix functions, names of fields, constants, and arithmetic operators to create powerful formulas that can be used in a variety of places. The formulas can be used to create computed fields in the data base or a report, help you to select records from the file for observation, help you to select records from the file for observation and analysis, and perform, summary computations in a report.

6. The analytical features of Reflex are provided through the use of selection formulas, graphics and Crosstab. Crosstab is an amazingly powerful tool for the analysis of your data, allowing you to perform each of the following operations, singly or in combination:

- A. Select the data (records) to be examined.
- B. Specify a summary function and a field to be summarized. The summary functions allow you to count, sum, and average, as well as compute the variance, standard deviation, minimum, and maximum.
- C. Group the data by field values. For example, you can easily obtain the total sales volume for each salesperson in the organization (data grouped by salesperson), the total sales to each company (grouped by company name), and the total sales volume by sales personnel to individual companies (grouped both by salesperson and by company name).
- D. Specify ranges and group values by subranges.

These features are deceptively simple, since their use in combination can produce real insights into the nature of your data. I find that many of the processes that I used to perform with larger, more powerful and harder to use software, can be easily performed with Reflex. For example, as an instructor, I like to see what the distribution of grades are in a class. The Crosstab feature allows me to do this quite easily. I just specify that I want a count of grades in each subrange, where the subranges are given in groups of 10, going from 1 to 100 (0 to 9, 10 to 19, 20 to 29, etc.).

7. You can read data from a variety of files found in many popular data management systems. Reflex can read and convert dBASE, PFS, 1-2-3, Symphony, and ASCII files. The conversion is automatic, but you can intervene to make any changes that you desire.
8. The graphs that you display on the screen can be printed or plotted on a wide variety of devices. As a result, you can use Reflex to extend the capabilities of systems like dBASE II and dBASE III.

continued on page 91

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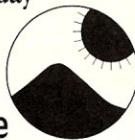
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Data Base Forum

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Reflex is not going to replace software development systems like dBASE III, Paradox, and R:base 5000 when your users need professional quality information systems requiring multiple files, but it may easily become the standard for the smaller, less professional user-built applications. Paradox has an interface that new users will probably find intimidating and I expect the new dBASE III interface will also intimidate most new users. There is a gap in the novice user market that I

think is nicely met by Reflex. Reflex is not intimidating to novice users and it offers important analytical tools not found in current versions of dBASE and similar products. When novice users find they have outgrown a system like Reflex, they may then find that the interface with products like Paradox and dBASE III are not as intimidating. The investment in Reflex is small enough (\$149.95) that later upgrades to another system could not be considered prohibitive. In addition, if the graphing and analytical features of Reflex are not incorporated into the new system, then

Reflex can still be used to extend the features of the new system. □

Nelson Dinerstein is an Associate Professor of Computer Science at Utah State University and an active consultant in database applications on micros. He has a Ph.D. in mathematics from the University of Utah. And, he is the author of 8 books on dBase-II/III, Framework, and R:base 5000 applications.

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UNIX File

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had an opportunity to examine and so don't feel prepared to comment on. There are also reference cards on many aspects of UNIX from Pitman, Specialized System Consultants, Cscapes and others.

Most of these books are listed in *Books in Print* or its updates, and can be ordered from your local bookseller. Mail order UNIX book dealers include Cucumber Info Systems, 5611 Kraft Ave, Rockwell, MD 20852, phone 301-984-3539, and Inside Information, 77 Harbord Street, Toronto, Ontario Canada M5S 1G4, phone 416-929-3244.

That's all for this month. I welcome electronic mail and letters on these and other topics, especially suggestions for future columns. Please write to me at Box 603, Station F, Toronto, Ontario, Canada M4Y 2L8. If you have UNIX mail access to the uucp network, mail "ihnp4!darwin!ian". I can't always answer immediately, but I will get back to you; electronic mail gets answered first! 

Ian Darwin is director of Research and Development for SoftQuad Inc, a company providing supported troff publishing software for UNIX. He and his wife live in a rural setting, north of Toronto.

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MARCH: MS-DOS Overview Part-I, Enhancing MP/M-II Part-2: adding login, date and time functions, Julian date Conversions, I/O changes for Fortran-80, CP/M Mass Renaming by Filetype, CP/M BIOS public domain enhancements, Power Failure Backup for S-100 systems; **REVIEWS:** MS-DOS for CompuPro From Computer House, Lomas Lighting One, Dual Systems SIO4, MagicBind, SAL/80K.

JANUARY: Enhancing MP/M-Part 1; Installing MP/M; Add Concurrency to MP/M; Two Users on CP/M; Relocating Assemblers & Linkage Editors-Part 3; S-100 Wait States; **REVIEWS:** MP/M-8/16, ProComp-8, Paragraphs Game Board, ProLog.

1983

NOVEMBER: Intro to 80286, 68000, and 16032 Microprocessors; Intro to Local Area Networks-Part 2; Extended Memory Management for older S-100 Systems; Notes on Microsoft Fortran-80; Building S-100 Parallel Ports; **REVIEWS:** CompuPro CPU-68K, System 8/16, Xenith Z-100, Nevada & Ellis Computing Fortran.

OCTOBER: Intro to Local Area Networks, Part-1; Build Low-Cost LAN; Build S-100 Bubble Memory Card; Use Radio Shack Model 100 portable with a CP/M system; Write Menu Driven Utility for Setting Printer Options; North Star Improvement; True Z-80 Random Number Function; Hide Code in Basic REM statement; Machine Code loader for MBasic; Increase Single-Density Disk Formatting; Relocating Assembler & Linkage Editors, Part-2; Run MX-80 with North Star; User Group Directory; CP/M-86 Versus CP/M-80; **REVIEWS:** CP/NET, QBAX, S-Basic.

AUGUST: XERA Program; Logging-On CP/M; WordStar Date/Time Patch; Find Location of Variable in North Star Basic; Prevent System Crashes During Warm Boot; Enhance Spreadsheet Print Files; Plot-

ting Package-Part 3; Run WordStar under TP/M; 50-line Text Formatter; Using the LU Utility; User Areas under CP/M; **REVIEWS:** Stiff Upper Lisp, MuLisp-80, Supersoft Lisp, Cromenco C-10, Access Manager, Fancy Font, Computime SBC-880 S-100 card.

JULY: Using RCPMs; RCPM Directory; PIP Data Between Computers; Toward Smarter Modem Programs; Interface MX-80 via Parallel Interface; Digital Audio On CP/M System; Customize CP/M CBIOS; Plotting Package Part-2; **REVIEWS:** DRI PL/I-86 and PL/I-80, S-100 PMMI MM-VTI.

JUNE: Plotting Package Part 1; Drive HP Plotter; Laboratory Graphics Applications; Console Keypressed interrupts; Customize Wordprocessor Keyboard; WordStar Patch for H-19/Z-19 Terminal; Relocatable Code; **REVIEWS:** Graftalk, Jes S-100 Graphics Controller, ZCPR2.

APRIL: IEEE-488 Tutorial; Interfacing to Lab Instruments; CP/M-86 System in Lab; Implementing CP/M + PART II; Build Simple S-100 Card Extractor; Macros & MacroAssemblers; **REVIEWS:** Pickles & Trout S-100 488 Controller; CP/M Utilities; Morrow Decision I.

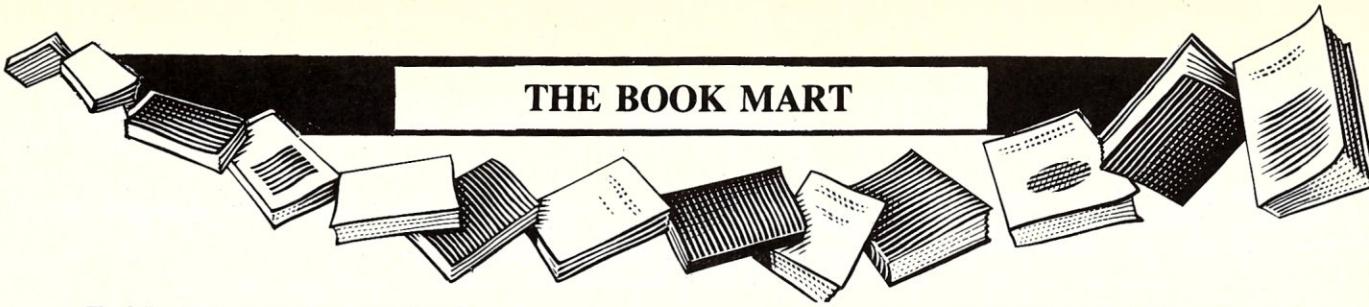
1982

NOVEMBER/DECEMBER: CP/M vs. MS/DOS; CP/M-86 vs. MS-DOS; Intro to ADA Part 2; Virtual Disk for NorthStar; CP/M Program Auto-execute; Macros & Macro-Assemblers; **REVIEWS:** Janus, Aztec-C, C/80, Morrow S-100 M26 Hard Disk System, Teleram S-100 Bubble Memory Card, Jade S-100 Bus Probe.

1981

NOVEMBER/DECEMBER: Introduction to the C Language, Virtual Segment Procedures, Little-Ada Part-II, A Disk Alignment Routine, Northstar DOS/BIOS Directory & File Conversion using UCSD Pascal; **REVIEWS:** BDS-C, Small-C, Tiny-C and Whitesmiths-C; Tarbell Double-Density Disk Controller.

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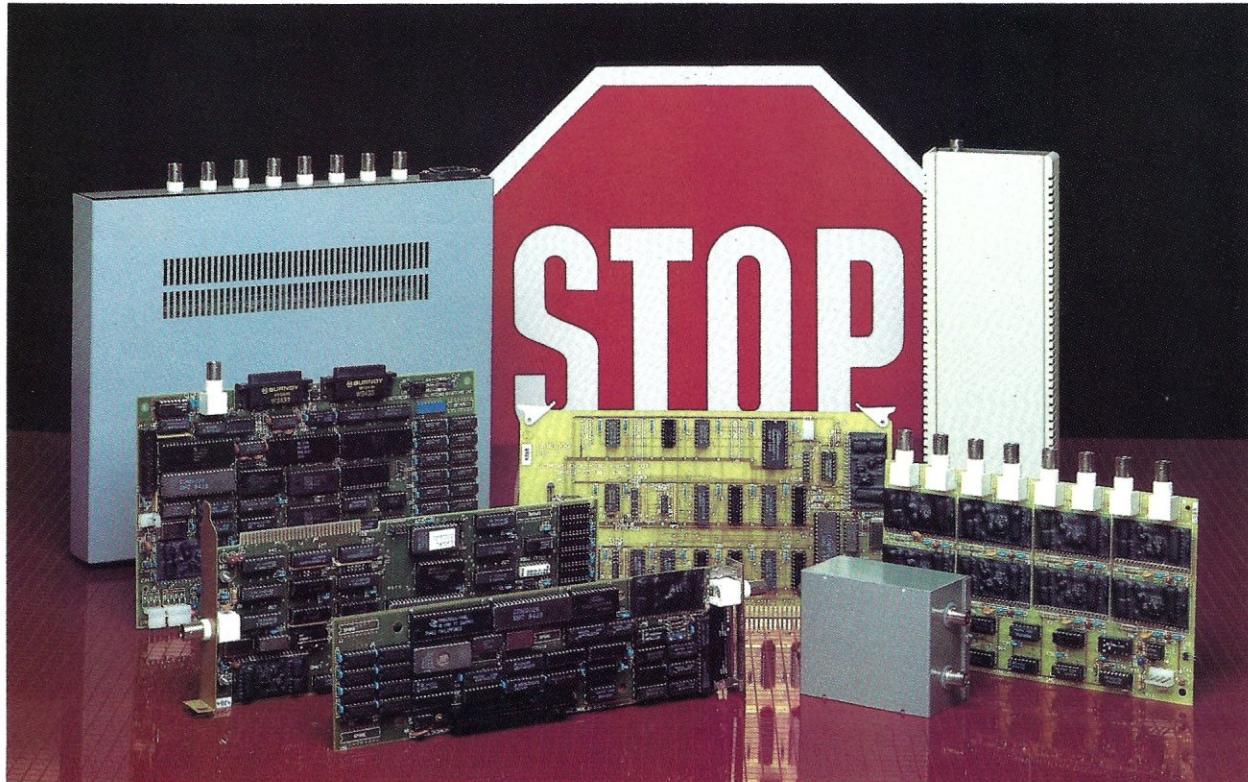
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